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UNIVERSAL EXPOSITION, ST. LOUIS, U.S.A.
1904.

DAVID R. FRANCIS,
President of Exposition.

HOWARD J. ROGERS,
Director of Congresses.

TRANSACTIONS

OF THE

Fourth International Dental Congress

HELD AT

ST. LOUIS, MO., U.S.A.,

August 29 to September 3, 1904.

EDITED FOR THE COMMITTEE OF ORGANIZATION
BY EDWARD C. KIRK, WILBUR F. LITCH,
AND JULIO ENDELMAN.

IN THREE VOLUMES.

VOL. I.

Philadelphia.
PRESS OF THE "DENTAL COSMOS."
The S. S. White Dental Mfg. Co.
1905.

Fourth International Dental Congreſs.

VOL. I.

NOTICE.

The Fourth International Dental Congress neither assumes responsibility for, nor lends its indorsement to, any statements contained in the various communications and discussions printed in this volume.

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Fourth International Dental Congress.

HISTORICAL.

THE inception of the movement which led to the organization and holding of the Fourth International Dental Congress originated within the membership of the National Dental Association of the United States of America at its annual meeting held at Niagara Falls in August 1902. At that meeting the suggestion was made by Dr. Burton Lee Thorpe of St. Louis to hold an International Dental Congress which should set forth the existing status of dental science and art, during the holding of the World's Fair in St. Louis in 1904, said congress to be placed under the patronage of the Universal Exposition of St. Louis and under the auspices of the National Dental Association as the inviting body.

The matter was considered informally by a number of the members of the National Dental Association, and a plan was formulated which was later officially confirmed by the National Dental Association upon the recommendation of its Executive Council. The plan involved, first, a resolution providing that an International Dental Congress should be held. Second, in view of the international scope of the proposed congress and having in mind the importance of the effort being made by the Fédération Dentaire Internationale toward harmonizing and unifying the world's dental interest, and appreciating the value of the work of that body, it was felt that courteous recognition thereof should be made; therefore an additional resolution providing for the affiliation of the Fédération Dentaire Internationale with the movement to establish a Fourth International Dental Congress was also provided.

The resolutions embodying these two steps in the work of organization were introduced at the morning session on July 28, 1902. The text of the resolutions, which were regularly adopted, was as follows:

Resolution No. 1.

Whereas, In 1904 there will be held an International Exposition in St. Louis, Mo., U. S. A., to be known as the Louisiana Purchase Exposition, in connection with which provision has been made for the holding of a series of international congresses, some of which are already organized; and

Whereas, The dental profession in America have been requested to organize in connection therewith a congress which shall adequately represent the interests and attainments of dentistry; therefore be it

RESOLVED, That the National Dental Association of the United States of America hereby invites the committee of the Fédération Dentaire Internationale having in charge the promotion of the Fourth International Congress to designate St. Louis, Mo., U. S. A., as the place, and the month of August 1904 as the time, for holding said international congress.

Resolution No. 2.

Whereas, The National Dental Association has adopted a resolution inviting the committee of the Fédération Dentaire Internationale having in charge the promotion of the Fourth International Dental Congress to designate St. Louis as the place, and August 1904 as the time, for holding said congress; therefore be it

RESOLVED, That three commissioners be appointed by the President of this Association to convey to the committee of the Fédération Dentaire Internationale having in charge the promotion of the Fourth International Dental Congress the cordial invitation of the dental profession of America, through its National Association, to unite in the holding of a congress, to be called the Fourth International Dental Congress, at the time and place stated.

Provision for the active work of organization was made by the following resolution, which was introduced by the Council and adopted on July 30, 1902:

Resolution No. 3.

RESOLVED, That a committee of fifteen be appointed by the President of the National Dental Association for the purpose of taking charge of an International Dental Congress proposed to be held at St. Louis, under the auspices of the Louisiana Purchase Exposition, in 1904; such committee to have full power to organize and conduct the congress. This committee, when appointed, to be for the present a provisional committee

> subject to the acceptance of an invitation now on its way to the committee of the Fédération Dentaire Internationale having in charge the promotion of the Fourth International Dental Congress. In the event of the acceptance of this invitation by the Fédération Dentaire Internationale, the said committee to be forthwith clothed with full power to commence and continue the work of organization. In case of a vacancy by death, resignation, or otherwise, the committee shall have power to fill the same.

The invitation provided for in Resolution No. 2 was transmitted to the International Dental Federation by three commissioners, Drs. Eugene H. Smith, Truman W. Brophy, and W. C. Barrett, and was officially accepted by the International Dental Federation, which body at the same time appointed a commission of nine members to represent the Fédération Dentaire Internationale in the work of organization.

Difficulties involved in the adjustment of the relations between the "committee of fifteen" of the National Dental Association and the "committee of nine" appointed by the International Dental Federation caused some delay in the work of organization due to a difference of opinion existing between the two committees as to which one was vested with ultimate authority to conduct the work of organization. This difficulty was happily settled by the decision of the Directory of Congresses of the Exposition, investing the committee of fifteen of the National Dental Association with authority to proceed with the work of organization,—from which point the work proceeded rapidly and efficiently.

Invitations were issued to the representative dental bodies in all countries to contribute to the program all matters which would tend to illustrate the advancement which had been attained in the science and art of dentistry in their respective countries.

Twenty-seven countries were represented by delegates at the Congress, and the membership reached a total of sixteen hundred, surpassing the membership record of any previous congress by about three hundred. Over one hundred and fifty papers were presented on the program, covering all departments of dental science and art.

In addition to the literary part of the program, two full mornings were devoted to clinical demonstrations illustrating the latest progress in dental technique.

Among the important results attained through the deliberations of the Congress was the emphasis placed upon the importance of more efficient dental service in connection with eleemosynary institutions and the defensive arms of governmental service, and better instruction of the public through the medium of the press and the public school systems in matters pertaining to the hygiene of the mouth and care of the teeth, together with the presentation of advanced ideas upon the questions of dental education and legislation.

The international character of the work and the international applicability of its results was enhanced further by the co-operative agency of the International Dental Federation, which convened just previous to the opening of the Fourth International Dental Congress, and reported the results of its deliberations to the latter body foi concurrence and ratification. The extent to which this was done is apparent in the resolutions passed at the general sessions of the Congress and recorded in the transactions of its closing session.

While the activities which have attended the creation and holding of this great meeting and the organization of the forces that have resulted in the vast quantity of matter comprised in the transactions of this Congress have not escaped criticism, nevertheless, judged by its output of work, the character of its program, the number of nations represented, the size of its membership, its financial conditions, and the stimulus which it has given to advanced work in dentistry and to international comity among dental practitioners, the Fourth International Dental Congress has easily surpassed in importance all of its predecessors.

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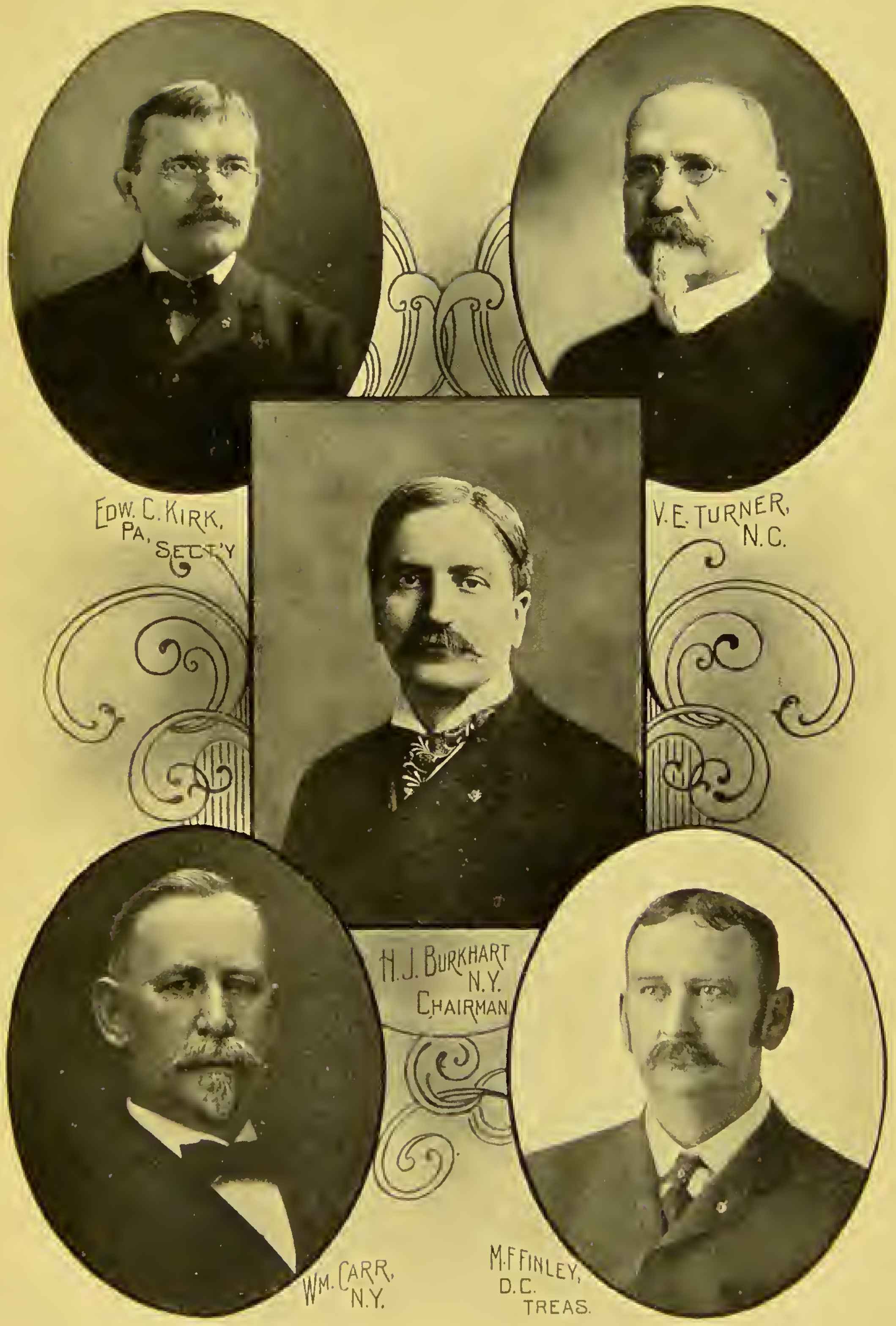
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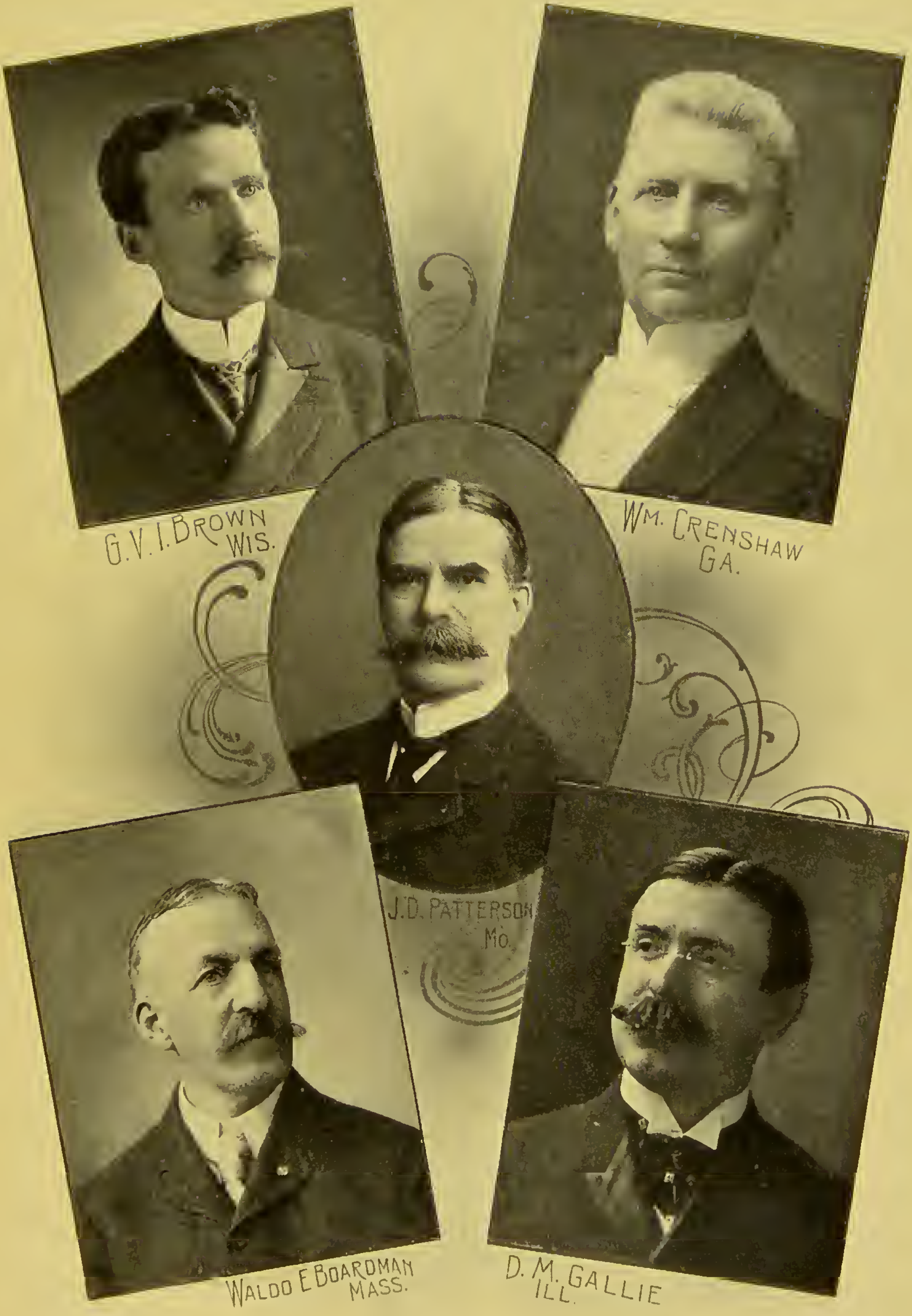

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FOURTH INTERNATIONAL DENTAL CONGRESS

Fourth International Dental Congreſs.

ORGANIZATION.

UNIVERSAL EXPOSITION, ST. LOUIS, U.S.A.

1904.

DAVID R. FRANCIS,
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Fourth International Dental Congress.

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Appel, George, 31 Washington St., Chicago, Ill.
Applegate, G. W., 2602 Locust St., St. Louis, Mo.
Arbeely, G. H., Damascus, Syria.
Armstrong, H. R., 171 West 126th St., New York, N. Y.
Arthur, H. W., 416 Smith Blk., Pittsburg, Pa.
Arthur, W. B., 3155 Shenandoah St., St. Louis, Mo.
Aschina, T., 374 Sutter St., San Francisco, Cal.
Ashbrook, J. S., 517 Smith Blk., Pittsburg, Pa.
Ashby, A. L., Ottawa, Kans.
Ashley, K. P., Deardorf Bldg., Kansas City, Mo.
Askew, J. B., Vicksburg, Miss.
Atwater, H. G., 1920 E. 4th St., Los Angeles, Cal.
Austin, J. M., 1121 Frederick St., St. Joseph, Mo.
Austin, W. F., Seneca, S. C.

B

Babcock, C. L., Colby Bldg., Milwaukee, Wis.
Baca, Antonio, Marquis de Larios 5, Malaga, Spain.
Bachman, C. A., Emans, Pa.
Bachman, C. C., Waterloo, N. Y.

Bagley, C. H., 1132 15th St., Denver, Colo.
Bair, J. T., 34 N. 9th St., Reading, Pa.
Baird, W. H., Burlington, Ia.
Baker, B. H., 1022 Jackson St., Wilmington, Del.
Baker, Hester I., Quincy, Ill.
Bale, H. N., Wellston, Ohio.
Ball, E. H., Tama, Ia.
Ballachey, F. A., 205 Norwood Ave., Buffalo, N. Y.
Banzet, G. T., 31 Washington St., Chicago, Ill.
Banzhaf, H. L., Wells Bldg., Milwaukee, Wis.
Barber, L. L., 311 Summit St., Toledo, Ohio.
Barber, S. J., Macleay Bldg., Portland, Ore.
Barcus, J. M., Carlinville, Ill.
Barker, J. Tenney, Wallingford, Conn.
Barnes, Henry, New England Bldg., Cleveland, Ohio.
Barnes, L. L., Paul's Valley, I. T.
Barnes, V. E., Rose Bldg., Cleveland, Ohio.
Barnwell, C. M., Inman Bldg., Atlanta, Ga.
Barr, C. W., Astoria, Ore.
Barr, H. D., Anniston, Ala.
Barrett, T. J., 492 Main St., Worcester, Mass.
Barron, S. L., Clarendon, Texas.
Bartel, L. W., 2603 Cass Ave., St. Louis, Mo.
Barton, W. J., Paris, Texas.
Baruch, J., 6 Rue de Berlaimont, Brussels, Belgium.
Bass, I. A., 3553 Olive St., St. Louis, Mo.
Bassett, F. L., Girard Bldg., Philadelphia, Pa.
Bassett, S. T., Century Bldg., St. Louis, Mo.
Bastyr, Alfred, Graben 30, Prague, Austria.
Batcher, W. H., Toledo, Ia.
Battle, W. H., Great Falls, Mont.
Bauer, Jos., 109 Bourbon St., New Orleans, La.
Bazan, V. de Zayas, Obispo 75 altos, Havana, Cuba.
Beach, J. R., Clarksville, Tenn.
Beach, J. W., 680 Main St., Buffalo, N. Y.
Beach, L. L., Bristol, Conn.
Beal, E. J., Sandy Lake, Pa.
Bear, E. W., Fullerton Bldg., St. Louis, Mo.
Beatie, A. L., Oregon City, Ore.
Beatie, E. L., Norborne, Mo.
Beauman, J. B., 4th and State Sts., Columbus, Ohio.
Beck, Rudolph, 92 State St., Chicago, Ill.
Becker, Emil F., 2253 S. Jefferson Ave., St. Louis, Mo.
Begun, A. R., 522 Walnut St., Des Moines, Ia.
Behrens, F. C., Westlich Bldg., St. Louis, Mo.
Bellchamber, C. E., Effingham, Ill.
Bender, O. J., Pollocksville, N. C.
Benkart, J. F., 614 Smith Blk., Pittsburg, Pa.
Bentley, C. E., 100 State St., Chicago, Ill.
Bercier, A. J., Opelousas, La.
Berg, N. A., 210 Lenox Ave., New York, N. Y.
Bethel, L. P., 1255 Neil Ave., Columbus, Ohio.
Betts, J. S., Greensboro, N. C.
Bibber, W. R., Eastport, Me.
Birkett, C. H., East Liverpool, Ohio.
Birkland, J. W., 2231 Prairie Ave., Chicago, Ill.
Black, A. D., 31 Washington St., Chicago, Ill.
Black, F. L., Bluefield, W. Va.
Black, G. V., Lake and Dearborn Sts., Chicago, Ill.
Blair, E. K., Waverly, Ill.
Blaisdell, E. C., Portsmouth, N. H.
Blakeman, R. I., Willoughby Bldg., Indianapolis, Ind.
Blanchard, E. O., Randolph, Vt.
Bland, C. A., Charlotte, N. C.
Bloomstein, Harry, El Paso, Texas.
Boardman, Waldo E., 184 Boylston St., Boston, Mass.
Boatner, H., Springfield, Mo.
Bödecker, C. F. W., Unter den Linden 54, Berlin, Germany.
Bogle, R. Boyd, 623½ Church St., Nashville, Tenn.
Bogue, E. A., 63 West 48th St., New York, N. Y.
Bogue, J. C., Harriman, Tenn.
Bohn, H. W., 34 N. 9th St., Reading, Pa.
Bond, Scipio, Anoka, Minn.
Booth, C. N., Cedar Rapids, Ia.
Booth, D. N., 222 East Broadway, New York, N. Y.
Booth, J. J., Marion, Ia.
Booth, W. W., Carnegie, Pa.
Boozer, J. W., Columbia, S. C.
Bordner, C. M., Shenandoah, Pa.
Bouche, L. F., Winnipeg, Manitoba, Can.
Bowles, J. D., Tipton, Mo.
Bowman, G. A., 3605 Delmar Ave., St. Louis, Mo.
Boyd, C. L., Montgomery, Ala.

Boyd, H. D., Jr., Troy, Ala.
Boyd, H. T., Sweet Water, Tenn.
Brabson, B. D., 522½ E. Gay St., Knoxville, Tenn.
Braham, J. V., Doe Run, Mo.
Brame, Frank, Windsor, Mo.
Brand, L. W., Benton, Ill.
Brashear, K. C., Wellsburg, W. Va.
Bratt, C. B., 800 Arch St., Allegheny, Pa.
Breen, J. M., 125 E. 16th St., New York, N. Y.
Breene, F. T., Iowa City, Ia.
Brennan, F. D., Ashland, Wis.
Brennan, J. D., Shenandoah, Pa.
Brenneman, D. M., Hobart, Okla.
Brewer, A. C., 520 N. Charles St., Baltimore, Md.
Bricker, F. A., Fargo, N. D.
Bridgeford, J. L., Macon, Mo.
Brierley, W. A., 70 Barth Blk., Denver, Colo.
Briggs, E. C., 129 Marlboro St., Boston, Mass.
Brigham, W. I., South Framingham, Mass.
Bringhurst, T. P., Shawnee, Okla.
Brinkman, M. R., Hackensack, N. J.
Broadbent, Wm., Eagle Bldg., Salt Lake City, Utah.
Bronson, G. A., 3201 Washington Ave., St. Louis, Mo.
Brooks, J. H., Burlington, N. C.
Brophy, R. C., 72 Canal St., Chicago, Ill.
Brophy, T. W., Marshall Field Bldg., Chicago, Ill.
Brown, A. J., 1928 L St., N. W., Washington, D. C.
Brown, E. Parmly, 509 5th Ave., New York, N. Y.
Brown, G. L., St. Petersburg, Fla.
Brown, G. V. I., 445 Milwaukee St., Milwaukee, Wis.
Brown, H. C., 185 E. State St., Columbus, Ohio.
Brown, O. W., El Paso Bldg., Denver, Colo.
Brown, W. E., Holland Bldg., St. Louis, Mo.
Brown, Wm., Sumner, Ill.
Bruner, C. W., Waterloo, Ia.
Brunton, George, 16 Blenheim Terrace, Woodhouse Lane, Leeds, England.
Brush, Edith R., Daytona, Fla.
Bruske, J. S., Amsterdam, Holland.
Bryan, J. W., Russellville, Ky.
Bryan, L. C., I St. Albananlage, Basel, Switzerland.
Bryant, E. A., 1320 New York Ave., Washington, D. C.
Bryant, E. C., Pittsfield, Me.
Buchanan, J. L., Bonham, Texas.
Buckley, J. P., 578 W. Madison St., Chicago, Ill.
Bull, H. D., Jerseyville, Ill.
Bumgardner, Edward, Lawrence, Kans.
Burgess, J. K., 117 W. Franklin St., Baltimore, Md.
Burgess, R. M., Jr., Paris, Mo.
Burke, G. L., Owensboro, Ky.
Burket, J. F., Kingman, Kans.
Burkhart, H. J., Batavia, N. Y.
Burne, A., 1 Lyons Terrace, Liverpool St., Sydney, Australia.
Burnett, John S., Montevideo, Uruguay.
Burns, J. B., Payette, Idaho.
Burroughs, E. L., Edwardsville, Ill.
Butler, C. S., The Frontenac, Buffalo, N. Y.
Byram, J. Q., 131 E. Ohio St., Indianapolis, Ind.

C

Cabbage, E. V., Bonanza, Yukon Ter., Canada.
Cahill, W. H., 75 Pratt St., Hartford, Conn.
Calais, Pierre, Hohenbleichen 17, Hamburg, Germany.
Calhoun, J. F., Birmingham, Ia.
Callahan, J. R., 25 Garfield Place, Cincinnati, Ohio.
Calvert, J. T., Spartanburg, S. C.
Cameron, G. S., Beaver Hall Hill, Montreal, Que., Canada.
Cameron, S. P., 1516 Locust St., Philadelphia, Pa.
Campbell, D. D., Ozark, Mo.
Campbell, Francis, Beaver City, Utah.
Campbell, H. W., Suffolk, Va.
Campbell, S. A., Mattoon, Ill.
Campbell, T. J., Okalona, Miss.
Campion, G. G., 264 Oxford Road, Manchester, England.
Capon, W. A., Real Estate Trust Bldg., Philadelphia, Pa.
Cappel, C., Evergreen, La.
Carlene, H. O., 1190 Sheffield Ave., Chicago, Ill.
Carlisle, J. P., Greenville, S. C.
Carlson, K. E., care of Surgeon-General, New York Life Bldg., St. Paul, Minn.
Carmody, T. E., Masonic Bldg., Denver, Colo.

Carpenter, Alden, care of Surgeon-General, U. S. Army, Washington, D. C.
Carpenter, E. R., Cable Bldg., Chicago, Ill.
Carpenter, G. T., 67 Wabash Ave., Chicago, Ill.
Carpenter, M. C., Portsmouth Bldg., Kansas City, Kans.
Carr, Wm., 35 West 46th St., New York, N. Y.
Carroll, R. W., Beaumont, Texas.
Carter, W. M., Sedalia, Mo.
Case, C. S., Stewart Bldg., Chicago, Ill.
Cassel, H. F., 2602 Locust St., St. Louis, Mo.
Cassidy, J. S., Covington, Ky.
Cassullo, Francisco, Andes 206, Montevideo, Uruguay.
Casto, F. M., Schofield Bldg., Cleveland, Ohio.
Cate, A. W., Boisé, Idaho.
Cattermole, F. P., Boulder, Colo.
Caush, D. E., 63 Grand Parade, Hove, Brighton, England.
Cave, Daniel, Lankersheim Bldg., Los Angeles, Cal.
Cave, W. L., 115 S. 17th St., Philadelphia, Pa.
Chace, J. E., Ocala, Fla.
Chace, W. G., Princeton, N. J.
Chaffee, J. B., Carthage, Mo.
Chambers, E. O., Asheville, N. C.
Chambers, W. T., California Bldg., Denver, Colo.
Chance, Arthur W., Dekum Bldg., Portland, Ore.
Chandler, V. K., Delavan, Ill.
Chappell, H. G., Central Bank Bldg., Oakland, Cal.
Charlson, O. O. S., Lindsburg, Kans.
Chase, Emma Eames, 3334 Washington Ave., St. Louis, Mo.
Chase, R. M., Bethel, Vt.
Cheeseman, F. E., 31 Washington St., Chicago, Ill.
Cherry, W. W., Olivia Bldg., St. Louis, Mo.
Chilcott, L. S., Bangor, Me.
Chittenden, C. C., Madison, Wis.
Christiansen, E. G., Drammen, Norway.
Cienfuegos, Mariano Ureta, Casilla 111, Santiago, Chile.
Cigrand, B. J., North and Milwaukee Aves., Chicago, Ill.
Clack, W. R., Clear Lake, Ia.
Clapp, D. M., 130 Commonwealth Ave., Boston, Mass.
Clark, E. G., Marquam Bldg., Portland, Ore.
Clark, F. E., Honolulu, Hawaii.
Clark, G. K., Russellville, Ky.
Clark, H. T., Longmont, Colo.
Clark, J. W., Courier-Journal Bldg., Louisville, Ky.
Cleland, Wm., Ferguson Bldg., Detroit, Mich.
Cleveland, W. W., Louisiana, Mo.
Clifton, R. H., Smyrna, Del.
Cochran, G. W., Erie, Pa.
Cochran, Victor, 1628 N. 17th St., Philadelphia, Pa.
Cockrill, F. M., Leavenworth, Kans.
Cogan, W. N., The Sherman, Washington, D. C.
Colbert, W. B., Ackerman, Miss.
Coleman, C. B., Poplar Bluff, Mo.
Colleran, Wm., La Crosse, Wis.
Collins, C. C., Athens, Ala
Collins, G. W., Vermillion, S. D.
Collins, T. J., 250 St. Antoine St., Detroit, Mich.
Collins, T. J., Princes St., Dunedin, New Zealand.
Collins, W. M., 6131 Easton Ave., St. Louis, Mo.
Colson, C. Bunting, 222 King St., Charleston, S. C.
Colter, F. H., Oklahoma City, Okla.
Combs, H. F., Stewart Bldg., Chicago, Ill.
Comegys, J. M., Shreveport, La.
Condon, J. J., Effingham, Ill.
Conkey, F. M., Homer, Ill.
Conner, W. B., Akron, Ohio.
Conner, W. H., Stillwater, Okla.
Conrad, Wm., 3666 Olive St., St. Louis, Mo.
Conroy, J. R., Belleville, Ill.
Contris, W. W., La Independencia 16, Mexico City, Mexico.
Conzelman, O., 3860 S. Broadway, St. Louis, Mo.
Conzett, J. V., Dubuque, Ia.
Cook, G. W., 4700 Kenwood Ave., Chicago, Ill.
Cooke, A. R., University Blk., Syracuse, N. Y.
Cooke, W. H., Clarendon, Texas.
Cooke, W. P., 330 Dartmouth St., Boston, Mass.
Corbett, C. C., Edwardsville, Ill.
Corley, J. P., Greensboro, Ala.
Cormany, J. W., Mt. Carroll, Ill.
Corwin, J., 100 State St., Chicago, Ill.
Coston, W. A., Fort Scott, Kans.
Cotten, T. H., Carthage, Miss.
Cottrell, H. V., 167½ S. High St., Columbus, Ohio.

Cowan, J. W., Geneseo, N. Y.
Cowdery, C. C., 5746 Vernon Ave.. St. Louis, Mo.
Cox, LeGrand M., Stockton, Ill.
Cox, N. R., Abington Bldg., Portland, Ore.
Cramer, J. E., Carrollton, Ga.
Crandall, W. G., Ballinger Bldg., St. Joseph, Mo.
Crandall, W. G., Spencer, Ia.
Crawford, J. Y., Jackson Bldg., Nashville, Tenn.
Creath, W. E., Ottumwa, Ia.
Crenshaw, Thomas, Prudential Bldg., Atlanta, Ga.
Crenshaw, Wm., Prudential Bldg., Atlanta, Ga.
Crews, C. C., Tyler, Texas.
Crombe, Ricardo, Calle de Medinas 20, Mexico City, Mexico.
Cronkhite, F. P., Ballinger Bldg., St. Joseph, Mo.
Crouse, J. N., 2231 Prairie Ave., Chicago, Ill.
Crumbaker, H. E., Altoona, Pa.
Crume, A. L., Augusta, Ark.
Cruttenden, H. L., Northfield, Minn.
Cryer, M. H., Crozer Bldg., Philadelphia, Pa.
Cudworth, W. H., 128 Wisconsin St., Milwaukee, Wis.
Culbertson, George, Emporia, Kans.
Culver, M. B., 1529 Locust St.. Philadelphia, Pa.
Cummings, W. A., Marquam Bldg.. Portland, Ore.
Cummins, J. T., Metropolis, Ill.
Cunningham, B. C., Colgate, I. T.
Cunningham, P. T.. 3133 Pine St., St. Louis, Mo.
Custer, L. E., 28 N. Ludlow St., Dayton, Ohio.
Cuthbertson, C. W., 309 7th St., N. W., Washington, D. C.
Cutler, A. B., Kalispell, Mont.
Cutler, W. E., Chanute, Kans.

D

Dailey, M. H., Paris, Ky.
Dailey, W. M., 30 West 39th St., New York, N. Y.
Dale, J. A., 217½ N. Summer St., Nashville, Tenn.
Dalrymple, W. G., Ogden City, Utah.
Dameron, E. P., De Malia Bldg., St. Louis, Mo.
Dana, A. W., Burlington, Ia.
Daniels, G. E., 843 Hyde St., San Francisco, Cal.
Darby, C. H., German-American Bank Bldg., St. Joseph, Mo.
Darby, E. T., 1631 Walnut St., Philadelphia, Pa.
Darby, R. E., Springfield, Mo.
Daugherty, T. E., Guthrie Center, Ia.
Davenport, I. B., 30 Ave. de l'Opera, Paris, France.
Davenport, Kirk A., 20 Stratford Place, London, Eng.
Davenport, W. S., 30 Ave. de l'Opera, Paris, France.
David, J. W., Corsicana, Texas.
Davidson, W. E., Holdredge, Nebr.
Davies, O. V., Dunedin, New Zealand.
Davis, H. E., St. Joseph, Ill.
Davis, H. S., 595 Geary St., San Francisco, Cal.
Davis, H. W., McCormick Bldg., Salt Lake City, Utah.
Davis, L. E., Granville, Ohio.
Davis, L. F., 1108 New York Ave., N. W., Washington, D. C.
Davis, S. G., 607 13th St., N. W., Washington, D. C.
Davis, W. J., 51 Mercantile Blk., Salt Lake City, Utah.
Davis, W. R., Whiteville, N. C.
Davison, C. W., Jefferson City, Mo.
Davison, H. M., Hubbard City, Texas.
Day, C. W., Vinita, I. T.
Deane, W. C., 616 Madison Ave., New York, N. Y.
Deichman, G. L., Madison and Howard Sts., Baltimore, Md.
Delbridge, W. H., Greeley, Colo.
De Long, W. D., 801 Penn St., Reading, Pa.
Denton, H. B., Eveleth, Minn.
De Puy, Hiram, 339 5th Ave., Pittsburg, Pa.
Derby, A. J., Honolulu, Hawaii.
Detwiler, B. B., Herndon, Va.
Dewey, J. S., Alturas, Cal.
Dewey, M., Grand Rapids, Mich.
Dicken, W. A., Attica, Ind.
Dickinson, W. P., Andrus Bldg., Minneapolis, Minn.
Diedel, Charles, 1015 H St., N. W., Washington, D. C.
Dieffenderfer, W. E., The Colorado, Washington, D. C.

Dieterich, J., Carlyle, Ill.
Dietrich, Wm., 1830 Baxter Ave., Louisville, Ky.
Dills, W. B., 260 De Kalb Ave., Brooklyn, N. Y.
Dittman, G. W., Apple River, Ill.
Dodel, X., 1307 Howard St., San Francisco, Cal.
Dodge, C. H., Odin, Ill.
Dodson, S. E., Grand Rapids, Mich.
D'Oench, H. F., 2901 Lafayette Ave., St. Louis, Mo.
Donnally, Williams, 1022 14th St., N. W., Washington, D. C.
Donnegan, E. J., 110 Washington Ave., Scranton, Pa.
Donnell, T. G., 2247 S. Grand Ave., St. Louis, Mo.
Donnelly, J. A., Fall River, Mass.
Dotterer, L. P., 102 Broad St., Charleston, S. C.
Douglass, J. K., Sandusky, Ohio.
Dowden, J. E., Fairmont, W. Va.
Dowsley, J. F., 175 Tremont St., Boston, Mass.
Doyle, B. O., 206 W. Chestnut St., Louisville, Ky.
Draper, C. A., Windsor, Mo.
Dreher, A. H., Salisbury, N. C.
Dreher, J. H., Wilmington, N. C.
Dressel, H. G., 323 S. Western Ave., Chicago, Ill.
Driscoll, W. E., Bradentown, Fla.
Dubeau, Eudore, 396 St. Denis St., Montreal, Que., Canada.
Dubois, C. A., 36 West 59th St., New York, N. Y.
Du Bouchet, C., 37 Boulevard Malesherbes, Paris, France.
Duff, D. E., Park and Madison Aves., Baltimore, Md.
Duncan, S. F., Joliet, Ill.
Dunford, A. B., Walker Bros. Bank Bldg., Salt Lake City, Utah.
Dunham, C. S., 1400 Olive St., St. Louis, Mo.
Dunning, W. B., 50 West 45th St., New York, N. Y.
Du Puis, L. V. P., Mayville, N. D.
Du Puy, T. M., Alexandria, La.

E

Eberle, Edward, 902 Main St., Hartford, Conn.
Ebersole, W. G., Schofield Bldg., Cleveland, Ohio.
Eble, Max M., Equitable Bldg., Louisville, Ky.
Edgar, G. D., Defiance, Ohio.
Edge, C. H., Houston, Texas.
Edmonds, N. D., Wilmington, Ohio.
Egbert, J. W., Bramley Villa, Oocatamund, Nilgiris, India.
Eggleston, Edward, 1 N. 6th St., Richmond, Va.
Eisloeffel, P. H., 2353 Lafayette Ave., St. Louis, Mo.
Elgin, A. C., 235 S. 42nd St., Philadelphia, Pa.
Elkins, L. C., St. Augustine, Fla.
Ellard, J. A., Birmingham, Ala.
Ellerbeck, W. L., Hooper Bldg., Salt Lake City, Utah.
Endelman, Julio, 12th and Chestnut Sts., Philadelphia, Pa.
Engel, H. S., Lineville, Ia.
Enloe, E. D., Cole Camp, Mo.
Enloe, H. V., Cole Camp, Mo.
Entsminger, G. W., Carbondale, Ill.
Epling, G. T., Keystone, W. Va.
Eschelman, S., Franklin and Virginia Sts., Buffalo, N. Y.
Esterly, G. A., Lawrence, Kans.
Eubank, George, Birmingham, Ala.
Evans, C. C., Colfax, Ill.
Evans, E. T., Decatur, Ill.
Evans, George, 55 West 39th St., New York, N. Y.
Evans, J. W., 4418 N. 21st St., St. Louis, Mo.
Evans, Paul W., Bond Bldg., Washington, D. C.
Evenson, J. E., Christiania, Norway.
Ewart, A. C., Marysville, Kans.
Ewart, H. E., St. Clair, Mich.
Exley, F. C., 202 Liberty St., Savannah, Ga.

F

Falero, Juan, Callejon del Espirito Santo 14, Mexico City, Mexico.
Faught, L. Ashley, 1430 Spruce St., Philadelphia, Pa.
Faulkner, T. H., Kinston, N. C.
Fawcett, A. C., Rochester, Minn.
Fay, M. L., 379 Hudson St., Buffalo, N. Y.
Fee, A. G., Superior, Wis.
Fellows, D. W., Portland, Me.
Feltus, H. J., Baton Rouge, La.

Fendler, Max, Missouri Trust Bldg., St. Louis, Mo.
Fenton, M. E., 262 Prospect St., Cleveland, Ohio.
Ferguson, D. A., 609 N. 2nd St., Richmond, Va.
Fessenden, H. W., Ottawa, Kans.
Ficks, W. L., 6200 Penn Ave., Pittsburg, Pa.
Field, Elizabeth, 1026 O St., Lincoln, Nebr.
Field, G. L., 4 Adams Ave., W., Detroit, Mich.
Fields, R. C., Lees Summit, Mo.
Fife, J. G., Dallas, Texas.
Figueroa, Ricardo, La Santo Domingo 8, Mexico City, Mexico.
Filbert, P. K., Pottsville, Pa.
Fillebrown, Thomas, 157 Newbury St., Boston, Mass.
Finley, M. F., 1928 I St., N. W., Washington, D. C.
Finney, W. B., 813 N. Eutaw St., Baltimore, Md.
Finn, Wm., Cedar Rapids, Ia.
Fischer, H. G., 1240 E. Ravenswood Park, Chicago, Ill.
Fischer, J. A., Missouri Trust Bldg., St. Louis, Mo.
Flanagan, A. J., 352 Main St., Springfield, Mass.
Fleming, A. H., Louisburg, N. C.
Fletcher, M. H., 11 E. 7th St., Cincinnati, Ohio.
Flickinger, Adam, 1113 Pine St., St. Louis, Mo.
Flint, D. W., 518 Smith Blk., Pittsburg, Pa.
Flood, A. M., 927 Market St., San Francisco, Cal.
Flower, J. O., 2917 Center Ave., Pittsburg, Pa.
Ford, L. E., 12 Muskegon Blk., Los Angeles, Cal.
Fordham, W. H., Connell Bldg., Scranton, Pa.
Förberg, Elof, 24 Sturegatan, Stockholm, Sweden.
Fort, A. K., Lake Charles, La.
Fossume, F. L., 616 Madison Ave., New York, N. Y.
Foster, S. W., 100 N. Butler St., Atlanta, Ga.
Foster, Wilson, Kenton, Ohio.
Foster, W. E., Danville, Ill.
Foster, W. G., 9 W. Franklin St., Baltimore, Md.
Fournier, J. N. P., St. Hyacinthe, Que., Canada.
Fowler, W. H., Painesville, Ohio.
Frame, C. L., 60 E. Broad St., Columbus, Ohio.
Franklin, F. W., Altman Bldg., Kansas City, Mo.
Franz, H., 31 Washington St., Chicago, Ill.
Frazier, A. E., High Point, N. C.
Frederich, V. H., 3263 S. Jefferson Ave., St. Louis, Mo.
Freeman, H. W., Grant Park, Ill.
Freeman, Solomon, 965 Madison Ave., New York, N. Y.
Freeman, S. A., 362 Jersey St., Buffalo, N. Y.
French, E. C., Eau Claire, Wis.
Fries, J. A., 1540 S. Broadway, St. Louis, Mo.
Friesell, H. E., 6200 Penn Ave., Pittsburg, Pa.
Frink, C. H., Fernandina, Fla.
Frink, J. L., Masonic Temple, Chicago, Ill.
Frisbie, E., Nice, France.
Frost, C. J., Warrensburg, Mo.
Frumveller, E. H., Shurley Bldg., Detroit, Mich.
Fruth, Otto, 3066 Hawthorne Boulevard, St. Louis, Mo.
Fry, J. T., Moberly, Mo.
Fulkerson, F. M., Sedalia, Mo.
Fuller, A. H., 318 N. 8th St., St. Louis, Mo.
Fuller, R. D., Ocala, Fla.
Fullerton, L. K., 423 Mack Blk., Denver, Colo.
Fuqua, Victor H., Stewart Bldg., Chicago, Ill.
Furrow, M. B., Guthrie, Okla.
Fynn, H. A., California Bldg., Denver, Colo.

G

Gallagher, J. W. S., Winona, Minn.
Gallie, D. M., 100 State St., Chicago, Ill.
Gardiner, F. D., 1516 Locust St., Philadelphia, Pa.
Gardiner, W. W., Frisco Bldg., St. Louis, Mo.
Gardner, H. J., Bardwell, Ky.
Garland, J. A., Alexandria, Ont., Canada.
Garside, W. O., Montgomery, Ala.
Gartrell, J. H., 47 Chapel St., Penzance, Cornwall, England.
Gary, A. G., Walker, Ia.
Gatterdam, E. A., La Crosse, Wis.
Gaylord, A. N., 1831 Chestnut St., Philadelphia, Pa.

Gaylord, E. S., 63 Trumbull St., New Haven, Conn.
Gendreau, J. G. A., 22 St. Lawrence St., Montreal, Que., Canada.
Gibbons, C. N., Godchaux Bldg., New Orleans, La.
Gibson, G. H., 2326 Russell Ave., St. Louis, Mo.
Gillespie, W. C., 625½ Church St., Nashville, Tenn.
Gillett, H. W., 130 Turo St., Newport, R. I.
Gilmer, T. L., 31 Washington St., Chicago, Ill.
Gingrich, C. M., 608 St. Paul St., Baltimore, Md.
Gires, Paul, 4 Rue de Rome, Paris, France.
Girling, Winthrop, 31 Washington St., Chicago, Ill.
*Goddard, C. L., 406 Sutter St., San Francisco, Cal.
Godon, Ch., 40 Rue Vignon, Paris, France.
Godsoe, F. A., 74 King St., St. John, N. B., Canada.
Goldsmith, S. L., 129 E. 60th St., New York, N. Y.
Good, Wesley, 409 Edmond St., St. Joseph, Mo.
Goode, Gladstone, 35 West 46th St., New York, N. Y.
Goodenough, G. D., Gowrie, Ia.
Goodrich, W. G., Chillicothe, Mo.
Gordy, A. P., Columbus, Ga.
Gorman, J. A., Asheville, N. C.
Goslee, H. J., 580 W. Madison St., Chicago, Ill.
Gothard, J. T., Alturas, Cal.
Gough, F. A., 595 Park Place, Brooklyn, N. Y.
Gould, A. W., Taylor, Texas.
Gowan, W. C., Creemore, Ont., Canada.
Gowan, C. M., Brunswick, Ga.
Grady, Richard, Annapolis, Md.
Graham, L. E., Sacramento, Cal.
Gramm, C. T., 103 State St., Chicago, Ill.
Granlof, L. D., Aberdeen, Miss.
Grant, W. E., Masonic Bldg., Louisville, Ky.
Grant, J. W., Oklahoma City, Okla.
Gravelle, A. W., 749 St. Catherine St., Montreal, Que., Canada.
Graves, J. W., 204 E. Main St., Rochester, N. Y.
Gray, J. P., 212 N. Spruce St., Nashville, Tenn.
Green, G. A., Grangeville, Idaho.
Green, L. O., 100 State St., Chicago, Ill.
Greene, F. A., Geneva, N. Y.
Greenwell, G. S. S., Aldworth, Fenton Road, Summer Hill, Sydney, Australia.
Greenwell, H. R., Aldworth, Fenton Road, Summer Hill, Sydney, Australia.
Gregg, G. T., 604 Smith Blk., Pittsburg, Pa.
Grevers, John E., 13 Oude Turf Markt, Amsterdam, Holland.
Grieves, C. J., Madison and Park Aves., Baltimore, Md.
Griffis, R. D., Paris, Texas.
Griffis, T. R., Carson, Ia.
Griner, O. T., Lakeport, Cal.
Grisamore, T. L., 1035 W. Van Buren St., Chicago, Ill.
Grisham, J. K., 432 Clark St., Cincinnati, Ohio.
Grissom, M. A., Cape Giradeau, Mo.
Griswold, E. R., Dansville, N. Y.
Gropper, Adolph, Goldsmith Bldg., Milwaukee, Wis.
Grosjean, S. S., Godchaux Bldg., New Orleans, La.
Grossman, M. E., Box 744, Honolulu, Hawaii.
Gruebbel, A. W., Concordia, Mo.
Guerin, E., Moulins, Alliers, France.
Guerini, Vincenzo, 257 Riviera di Chiaia, Naples, Italy.
Guilford, S. H., 1631 Walnut St., Philadelphia, Pa.
Gunther, H. A., 3300 Cottage Grove Ave., Chicago, Ill.

H

Haas, M. M., Evansville, Ind.
Habbeger, L. E., 406 Smith Blk., Pittsburg, Pa.
Hacker, T. S., Willoughby Bldg., Indianapolis, Ind.
Hackett, F. M., 413 Leavenworth St., San Francisco, Cal.
Hadley, E. E., 1400 Olive St., St. Louis, Mo.
Hagerty, R. E., Dubuque, Ia.
Hague, T. H., Huntington, Ind.
Hague, W. H., Delaware, Ohio.
Hair, G. F., Bamberg, S. C.
Hair, I. M., Union, S. C.
Hale, Robt. F., Wilmington, Ohio.
Hale, T. L., Watertown, Tenn.
Hale, W. R., Wilmington, Ohio.
Halferty, F. W., Lancaster, Wis.

---

* Deceased.

Hall, Charles, Blue St., North Sydney, Australia.
Hall, C. T., Cochran, Ga.
Hall, J. A., Collinsville, Ala.
Hall, L. P., Ann Arbor, Mich.
Hall, O. C., 155 53rd St., Chicago, Ill.
Hall, Willard, 15 Saville Row, London. W., England.
Hallenberg, Albert, Fargo, N. D.
Hampton, T. M., Helena, Mont.
Halsey, J. G., Swedesborough, N. J.
Hamilton, H. F., Newport, Vt.
Hammen, E. C, Lebanon, Ill.
Hammer, Oscar, 2519 Salena St., St. Louis, Mo.
Hammersmith, P. C., 781 Seneca St., Buffalo, N. Y.
Hampton, C. G., Jr., 970 Woodward Ave., Detroit, Mich.
Hanley, Sara S., 2 West 38th St., New York, N. Y.
Hanley, B. S., 3680 S. Broadway, St. Louis, Mo.
Harden, O. H., 722 E. 63rd St., Chicago, Ill.
Hardy, G. E., Madison and Howard Sts., Baltimore, Md.
Hardy, H. W., 129 Marlboro St., Boston, Mass.
Harlan, A. W., 1122 Broadway, New York, N. Y.
Harndon, F. W., 135 Geary St., San Francisco, Cal.
Harper, H. D., Jr., Kinston, N. C.
Harper, W. E., 3441 Wabash Ave., Chicago, Ill.
Harrell, H. B., Gainesville, Texas.
Harris, S. W., Chillicothe, Mo.
Harrison, B. T., 44 Barth Blk., Denver, Colo.
Harrison, Walter, 6 Brunswick Place, Hove, Brighton, England.
Hart, C. E., California Bldg., San Francisco, Cal.
Hart, John I., 118 West 55th St., New York, N. Y.
Hartman, J. A., Albion, N. Y.
Harvey, H. F., New England Bldg., Cleveland, Ohio.
Harvitt, Jos., 214 East Broadway, New York, N. Y.
Hasek, A. M., Cedar Rapids, Ia.
Haskell, L. P., 34 Washington St., Chicago, Ill.
Hassell, H. C., Tuscaloosa, Ala.
Hatfield, T. I., Marysville, Kansas.
Hauser, G. T., La Crosse, Wis.
Havel, M. V., Montgomery, Minn.
Haverstick, E. E., 346 N. Boyle Ave., St. Louis, Mo.
Hawkins, F. F., Troy, N. Y.
Hawley, C. A., The Chelsea, Columbus, Ohio.
Hayden, Gillette, 112 E. Broad St., Columbus, Ohio.
Haynes, G. F., Newton, Miss.
Hays, W. D., Greensburg, Pa.
Hayter, Mark, Dallas, Ore.
Head, Joseph, 1500 Locust St., Philadelphia, Pa.
Hecht, Hans, Bellevuestr. 18, Berlin, Ger.
Heckard, W. A., 35 Ingalls Blk., Indianapolis, Ind.
Heise, O. N., 16 Garfield Place, Cincinnati, Ohio.
Heflin, E. E., Ardmore, I. T.
Hempelman, W. F., New Haven, Mo.
Hendricksen, R., Christiania, Norway.
Henshaw, F. R., Middletown, Ind.
Herbert, W. C., Whitney Bldg., Detroit, Mich.
Hergert, F. W., 28 Coleman Blk., Seattle, Wash.
Hert, B. S., Chamber of Commerce, Rochester, N. Y.
Hertig, O. L., Shraderman Bldg., Pittsburg, Pa.
Hertz, J. C., 111 S. 4th St., Easton, Pa.
Hetrick, F. O., Ottawa, Kans.
Hickey, Jos., Dekum Bldg., Portland, Ore.
High, C. B., Honolulu, Hawaii.
Hildebrand, J. G., Waterloo, Ia.
Hill, E. B., Marlinton, W. Va.
Hillier, C. W., 935 W. 63rd St., Chicago, Ill.
Hindsley, Frederick, 1151 Main St., Bridgeport, Conn.
Hines, C. E., 314 2nd St., Memphis, Tenn.
Hines, Jennie E., Lead, S. D.
Hines, P. F., Lake Odessa, Mich.
Hinkins, J. E., 131 E. 53rd St., Chicago, Ill.
Hinkley, B. C., Keokuk, Ia.
Hinckley, F. B., Fall River, Mass.
Hinman, T. P., Inman Bldg., Atlanta, Ga.
Hirschi, R. O., Guthrie, Okla.
Hitch, D. M., 3315 Baring St., Philadelphia, Pa.
Hitch, G. A., Laurel, Del.
Hodge, H. W., Wichita, Kans.
Hodge, L. D., Arkansas City, Kans.
Hodge, S. D., Burlington, Vt.

Hodgen, J. D., 1005 Sutter St., San Francisco, Cal.
Hoff, N. S., Ann Arbor, Mich.
Hoffendahl, Kurt, Schellingstr. 16, Berlin, Germany.
Hoffer, H. W., Kaufman, Texas.
Hoffman, H. F., California Bldg., Denver, Colo.
Hofheinz, R. H., Chamber of Commerce, Rochester, N. Y.
Holbrook, C. F. W., 2 Saybrook Place, Newark, N. J.
Holcombe, P. D., Lexington, Miss.
Holden, G. M., Hackettstown, N. J.
Holden, J. A., Lincoln, England.
Holland, A. D., Newport, Ark.
Holland, Frank, Prudential Bldg., Atlanta, Ga.
Holland, W. E., Jerseyville, Ill.
Hollinger, O. Schiller Bldg., Chicago, Ill.
Hollingsworth, J. G., Rialto Bldg., Kansas City, Mo.
Holson, Alliene M., Grinnell, Ia.
Holton, J. R., Commercial Bldg., St. Louis, Mo.
Hood, R. J., Sparta, Ill.
Hopkins, H. P., Little Rock, Ark.
Hopkins, S. A., 235 Marlboro St., Boston, Mass.
Hosford, W. S., Iowa City, Ia.
Hough, G. B., Somerset, Pa.
Hough, W. C. P., 193 Macquarie St., Sydney, Australia.
Houghton, M. J., Valley Junction, Ia.
House, J. W., Grand Rapids, Mich.
Houston, J. F., Lewisburg, Tenn.
Houston, J. F., Rua Gonsalvas Dias 2, Rio de Janeiro, Brazil.
Houston, P. D., Lewisburg, Tenn.
Houston, W. C., Concord, N. C.
Howard, F. E., 331 Franklin St., Buffalo, N. Y.
Howard, N. U., Sedalia, Mo.
How, W. Storer, P. O. Box 1615, Philadelphia, Pa.
Howell, J. L., Creede, Colo.
Howell, I. B., Paducah, Ky.
Howlett, B. J., Ann Arbor, Mich.
Hubbell, C. R., La Junta, Colo.
Hubbuck, E. H., 323 4th St., Louisville, Ky.
Huey, Robt., 330 S. 15th St., Philadelphia, Pa.
Huffman, L. F., Lexington, Ky.
Hugo, C. J., Okawville, Ill.
Hulen, J. A., Centralia, Mo.
Hull, H. A., New Brunswick, N. J.
Hull, J. W., Altman Bldg., Kansas City, Mo.
Hulley, E. S., Marion, Ind.
Hume, E. J., Whitehall, Ill.
Hungerford, C. L., Rialto Bldg., Kansas City, Mo.
Hunt, A. O., Bee Bldg., Omaha, Neb.
Hunt, F. L., Asheville, N. C.
Hunt, George E., 131 E. Ohio St., Indianapolis, Ind.
Hunt, W. J., 254 2nd St., Memphis, Tenn.
Hurd, E. M., Salem, Ore.
Hurlbut, C. H., Evanston, Ill.
Hurst, L. D., 619 Mack Blk., Denver, Colo.
Hussey, C. B., Carthage, Mo.
Hutchins, M. C., Flint, Mich.
Hutchison, Raymond R., 5100 Penn Ave., Pittsburg, Pa.

I

Iglehart, T. N., 725 Sutter St., San Francisco, Cal.
Ingram, B. P., 5 West 8th St., Cincinnati, Ohio.
Iredell, Harvey, New Brunswick, N. J.
Irvin, R. E. D., Anniston, Ala.
Irwin, Alphonso, 425 Cooper St., Camden, N. J.
Ivy, Robert S., 17a The Bund, Shanghai, China.

J

Jack, Louis, 1533 Locust St., Philadelphia, Pa.
Jackman, W. T., Schofield Bldg., Cleveland, Ohio.
Jackson, A. M., Commercial Bank Bldg., Macon, Ga.
Jackson, H. H., 317 Jefferson Ave., Detroit, Mich.
Jackson, J. H., Burlington, Vt.
Jackson, J. S., California Bldg., Denver, Colo.
Jackson, W. G., Abilene, Texas.
Jackson, V. H., 240 Lenox Ave., New York, N. Y.
Jacobson, E., Hazelton, Kans.
Jacquette, W. A., Salem, N. J.
James, D. L., Greenville, N. C.
James, E. P., 121 Geary St., San Francisco, Cal.
James, F. B., Wilton Junction, Ia.
James, W. D., Tracy, Minn.
Jameson, G. L. S., 1415 Walnut St., Philadelphia, Pa.

Jarvie, William, 105 Clinton St., Brooklyn, N. Y.
Jefferis, C. R., New Century Bldg., Wilmington, Del.
Jenkins, H. E., Ironton, Ohio.
Jenkins, N. S., Walpurgisstr. 15, Dresden, Germany.
Jernigan, G. F., 61 West 56th St., New York, N. Y.
Jewett, H. R., The Grand Bldg., Atlanta, Ga.
Johnson, A. P., Fargo, N. D.
Johnson, C. N., Marshall Field Bldg., Chicago, Ill.
Johnson, E. A., Collinsville, Tenn.
Johnson, E. M., St. Cloud, Minn.
Johnson, H. C., Scimiter Bldg., Memphis, Tenn.
Johnson, H. H., Commercial Bank Bldg., Macon, Ga.
Johnson, I. B., Onarga, Ill.
Johnston, A. P., Anderson, S. C.
Johnston, J. F., Ruston, La.
Johnston, W. A., Peoria, Ill.
Jonas, I., Brooksville, Miss.
Jones, Bush, Dallas, Texas.
Jones, C. E., 813 W. Harrison St., Chicago, Ill.
Jones, F. C., Greenville, Ill.
Jones, L. D., San Diego, Cal.
Jones, L. G., San Diego, Cal.
Jones, P. H., Clear Lake, Ia.
Jones, R. H., Winston-Salem, N. C.
Jones, R. H., 408 Delaware Ave., Wilmington, Del.
Jones, W. I., Nelsonville, Ohio.
Jones, V. S., Bethlehem, Pa.
Joyner, P. M., Union City, Tenn.

K

Kaas, Carl, Universitetsgade 16, Christiania, Norway.
Kahlo, H. C., 115 E. New York St., Indianapolis, Ind.
Kammer, C. W., 2123 Madison Ave., Baltimore, Md.
Kassab, Wadea, 802 Edgemont Ave., Chester, Pa.
Keefe, D. F., Butler Exchange, Providence, R. I.
Keefe, J. E., 34 Washington St., Chicago, Ill.
Keeler, H. D., Century Bldg., Des Moines, Ia.
Keller, W. H., San Juan de Latran 4, Mexico City, Mexico.
Kelley, H. A., Portland, Me.
Kellogg, H. K., Equitable Bldg., Louisville, Ky.
Kellogg, R. D., Sioux City, Ia.
Kelly, A. B., Yazoo City, Miss.
Kelly, J. C., Newburyport, Mass.
Kelly, J. L., Germania Life Bldg., St. Paul, Minn.
Kelly, W. H., Wheeling, W. Va.
Kelsey, H. E., Madison and Howard Sts., Baltimore, Md.
Kemp, C. F., Key West, Fla.
Kempff, Fred, 209 N. 12th St., St. Louis, Mo.
Kendrick, M. A., Port Huron, Mich.
Kennerly, J. H., 2639 Locust St., St. Louis, Mo.
Ketcham, A. H., Masonic Bldg., Denver, Colo.
Kettig, E. M., 318 W. Walnut St., Louisville, Ky.
Keyes, Carlos, Rua Gonsalves Dias 2, Rio de Janeiro, Brazil.
Kiernan, J. G., Columbus Memorial Bldg., Chicago, Ill.
Kiess, H. W., Carleton Bldg., St. Louis, Mo.
Kimbrough, H. S., 1000 N. Jefferson Ave., St. Louis, Mo.
Kimbrough, J. B., 2610 Locust St., St. Louis, Mo.
King, H. T., Fremont, Neb.
King, W. C., 212 N. Spruce St., Nashville, Tenn.
Kingsley, F. J., Towanda, Pa.
Kirk, Edward C., 12th and Chestnut Sts., Philadelphia, Pa.
Kitchen, G. L., 3627 S. Broadway St., St. Louis, Mo.
Klingelhoefer, O., 9 Morskaja, St. Petersburg, Russia.
Klump, G. W., Williamsport, Pa.
Knapp, J. Rollo, 830 Canal St., New Orleans, La.
Knight, E. W., Bellows Falls, Vt.
Knox, H. B., 1111 Washington St., Oakland, Cal.
Koenig, E. L., 3305 Magnolia St., St. Louis, Mo.
Kohly, A. J., Tampa, Fla.
Komodsinsky, Mme. S. Vongl, St. Petersburg, Russia.
Koppel, G. H., Jacksonville, Ill.
Kraft, J. E., Albuquerque, N. M.
Kratzer, C. V., 111 N. 5th St., Reading, Pa.

Kraus, Moritz, X Keplerplatz I, Vienna, Austria.
Krause, J. L., Eureka, Ill.
Krupp, P. C., Houston, Texas.
Kuhl, F. G., 99 Main St., Woonsocket, R. I.
Kunkle, A. C., Greensburg, Pa.

L

Land, C. H., 64 Elizabeth St., Detroit, Mich.
Lange, H. F., Muscatine, Ia.
Lasater, R. L., Fayetteville, Tenn.
Latham, Vida A., 808 Morse Ave., Rogers Park, Chicago, Ill.
Lathrop, C. M., Toledo, Ia.
Law, E. A., Bartow, Fla.
Lawrason, A. N., Lansing, Mich.
Lawrence, W. H., Bryan, Texas.
Leake, W. J., Lockport, N. Y.
Leavitt, M. B., 4054 Indiana Ave., Chicago, Ill.
LeCron, D. O. M., Missouri Trust Bldg., St. Louis, Mo.
LeCron, R. N., Missouri Trust Bldg., St. Louis, Mo.
LeCron, S. L., 320 N. Charles St., Baltimore, Md.
Le Gro, A. L., Three Rivers, Mich.
Leighton, C. B., Portland, Me.
Lenty, Arthur, Alexandria, Egypt.
Lentz, O. A., Ryan Bldg., St. Paul, Minn.
Leonard, N. C., 625½ Church St., Nashville, Tenn.
Le Roy, L. C., 6 Lexington Ave., New York, N. Y.
Letord, J. S., Deardorf Bldg., Kansas City, Mo.
Levings, A. H., Wells Bldg., Milwaukee, Wis.
Lewis, A. M., Austin, Minn.
Lewis, J. H., Nez Perce, Idaho.
Libbey, J. A., 524 Penn Ave., Pittsburg, Pa.
Libby, A. A., 687 Boylston St., Boston, Mass.
Lindsay, L. H., Buchanan, W. Va.
Lindstrom, C. R., 31 Exchange St., Lynn, Mass.
Line, J. Edward, 39 State St., Rochester, N. Y.
Link, E. G., Cutler Bldg., Rochester, N. Y.
Lippincott, J. T., 1433 Walnut St., Philadelphia, Pa.
Lischer, B. E., Studio Bldg., St. Louis, Mo.
Litch, W. F., 1500 Locust St., Philadelphia, Pa.
Littig, J. Bond, 61 West 70th St., New York, N. Y.
Livingston, R. W., Clearfield, Pa.
Loar, B. M., Mt. Pleasant, Pa.
Locke, F. H., 1406 11th St., Oakland, Cal.
Lodge, A., 63 Salford, Lockwood, Huddersfield, Yorkshire, England.
Lodge, E. B., Rose Bldg., Cleveland, Ohio.
Loebenstein, Samuel, Altman Bldg., Kansas City, Mo.
Lofton, W. S., 1543 M St., N. W., Washington, D. C.
Logan, W. H. G., 31 Washington St., Chicago, Ill.
London, J. H., 1115 G St., N. W., Washington, D. C.
Long, A. M., Monroe, Mich.
Long, E. A., Forrest City, Ark.
Long, M., Eddyville, Ia.
Long, S. A., South McAllister, I. T.
Longeway, G. E., Great Falls, Mont.
Lorenz, J. H., Inman Bldg., Atlanta, Ga.
Loring, E. L., West Berkeley, Cal.
Losada, J. D., Barquillo 5, Madrid, Spain.
Louque, G. A., 830 Canal St., New Orleans, La.
Lourie, L. S., 92 State St., Chicago, Ill.
Love, J. F., Rue Nabi Daniel, Alexandria, Egypt.
Love, W. H., 3761 Finney Ave., St. Louis, Mo.
Low, F. W., 680 Main St., Buffalo, N. Y.
Lowry, F. M., Delevan, Ill.
Luckey, B. F., 88 Broadway, Paterson, N. J.
Luckey, S. B., 333 E. Broad St., Chester, Pa.
Luckie, R. K., Holly Springs, Miss.
Lumpkin, I. A., Mattoon, Ill.
Luxmore, Wm., Mariana, Fla.
Lyell, T. W., Shelbina, Mo.
Lynde, F. M., Barre, Vt.
Lynott, F. B., Frisco Bldg., St. Louis, Mo.

M

McAlpine, A., Bradford, Pa.
McAlpine, A. C., San Diego, Cal.
McAnnally, F. H., Jasper, Ala.
McArthur, C. Z., Fort Valley, Ga.
McBride, C. J., Perryville, Mo.
McBride, J. B., Springfield, Mo.
McCarter, W. A., 733 Kansas Ave., Topeka, Kans.
McCartney, J. G., Mitchell, S. D.
McClanahan, I. W., Friend, Neb.
McConnell, D. E., Gastonia, N. C.
McCowen, W., Ukiah, Cal.
McCrillis, M. S., Douglas, Wyo.

McCurdy, J. S., 825 Harrison St., Fort Wayne, Ind.
MacDonald, A. B., Enmore Terminus, Sydney, Australia.
McDonald, J. P., Shelbyville, Tenn.
McFadden, H. B., 3505 Hamilton St., Philadelphia, Pa.
McFerrin, Marvin, 619½ Church St., Nashville, Tenn.
McGavock, R. J., Spring Hill, Tenn.
MacGown, W. Y., 333 Union St., Lynn, Mass.
McIlroy, C. M., Delaware, Ohio.
McIntosh, F. H., Bloomington, Ill.
McKay, C. F., Knox City, Mo.
McKay, F. S., Colorado Springs, Colo.
McKelvy, W. A., Atchison, Kans.
McLaurin, L. B., Fayette, Miss.
McLean, W. T., Neave Bldg., Cincinnati, Ohio.
McManus, Charles, 80 Pratt St., Hartford, Conn.
McManus, Henry, 80 Pratt St., Hartford, Conn.
McManus, James, 80 Pratt St., Hartford, Conn.
McMillen, D. J., 11th and Locust Sts., Kansas City, Mo.
McMillan, H. W., Roseville, Ill.
McQuinston, J. P., 5443 Easton Ave., St. Louis, Mo.
McWilliams, J. F., Mexico, Mo.
Mack, W. F., Hooper Bldg., Salt Lake City, Utah.
Mackenzie, J. F., 391 Trumbull Ave., Detroit, Mich.
Madison, H. L., Burlington, Ia.
Maercklein, B. G., 307 Grand Ave., Milwaukee, Wis.
Magee, A. M., Louisiana, Mo.
Magee, J. M., St. John, N. B., Canada.
Malone, J. L., Superior, Wis.
Mandell, L. C., 4310 Cook Ave., St. Louis, Mo.
Manhard, O. H., Missouri Trust Bldg., St. Louis, Mo.
Mansen, David, Burlington, Vt.
Marchant, J. H., 314 N. Eutaw St., Baltimore, Md.
Markwell, R., Galveston, Texas.
Marlow, S. A., Bloomington, Wis.
Marsh, J. W., Warsaw, Ill.
Marshall, John S., care of Surgeon-General, U. S. Army, Washington, D. C.
Martin, C. A., Winfield, Kan.
Martin, Fr., 30 Rue de la République, Lyons, France.
Martin, George, Victoriastr. 10, Berlin, W., Germany.
Martin, W. T., Yazoo City, Miss.
Mason, W. G., Tampa, Fla.
Mason, M. A., Fort Wayne, Ind.
Mathae, G. H., 1428 Mississippi Ave., St. Louis, Mo.
Matkin, E. H., Bonne Terre, Mo.
Matteson, A. E., 3900 Cottage Grove Ave., Chicago, Ill.
Mathiason, C., Calle Florida 293, Buenos Aires, A. R.
Mathiason, P. B., Los Angeles, Cal.
MaWhinney, Elgin, 34 Washington St., Chicago, Ill.
Maxfield, F. E., Bangor, Me.
Maxfield, G. A., 390 High St., Holyoke, Mass.
Mayfield, I. T., Fort Worth, Texas.
Meade, C. M., Carmi, Ill.
Meadors, J. T., 625½ Church St., Nashville, Tenn.
Meeker, C. A., 29 Fulton St., Newark, N. J.
Meguiar, C. W., Munfordville, Ky.
Meisburger, L., 948 Main St., Buffalo, N. Y.
Mela, Rosilino, Genoa, Italy.
Melendy, A. R., Dearderick Bldg., Knoxville, Tenn.
Melia, Fillippo, Naples, Italy.
Melton, J. T., Weatherford, Texas.
Mentze, C., Bellville, Ill.
Menzies, W. P., Dyersburg, Tenn.
Mercer, C. L., 722 14th St., Denver, Colo.
Merchant, M. S., Giddings, Texas.
Meriwether, C. L., Louisiana, Mo.
Merriman, A. F., 1114 Washington St., Oakland, Cal.
Merritt, A. H., 413 Lexington Ave., New York, N. Y.
Messerschmitt, Frederick, Granite Bldg., Rochester, N. Y.
Meyer, L. A., Oconomowoc, Wis.
Meyers, E. A., Hamilton, Mont.
Michaels, J. P., 24 Rue Royale, Paris, France.
Milam, T. M., Little Rock, Ark.
Miller, C. B., Cedar Falls, Ia.
Miller, E. E., Geary, Okla.
Miller, E. A., Hopkins, Mo.
Miller, Jesse, Maryville, Mo.
Miller, O. L., 252 Scott St., San Francisco, Cal.

Miller, W. D., Kurfürstendamm 232, Berlin, Germany.
Millhouse, J. W. E., Blackville, S. C.
Mills, F. L., Nanticoke, Pa.
Mills, Leah, 513 Paxton Blk., Omaha, Neb.
Miner, G. H., Hutchinson, Kans.
Mitchell, C. B., Bowling Green, Mo.
Mitchell, G. D., Morrisville, Mo.
Mitchell, G. E., 25 Merrimack St., Haverhill, Mass.
Mitchell, L. D., Arkansas City, Kans.
Mitchell, L. J., 39 Upper Brook St., Grosvenor Sq., London, England.
Mitchell, Wm., 39 Upper Brook St., Grosvenor Sq., London, England.
Moffatt, R. T., 85 Newbury St., Boston, Mass.
Mohring, C. T., Neuerwall 14, Hamburg, Germany.
Molt, F. F., Arcade Bldg., Pullman, Ill.
Monfort, Lena S., Excelsior Springs, Mo.
Monroe, A. F., Flint, Mich.
Monroe, Grafton, Springfield, Ill.
Montaga, Tunetaro, Honolulu, Hawaii.
Moody, F. E., 26 Syndicate Blk., Minneapolis, Minn.
Moore, C. S., Witherspoon Bldg., Philadelphia, Pa..
Moore, E. C., 112 Miami Ave., Detroit, Mich.
Moore, J. Hall, 104 N. 9th St., Richmond, Va.
Moore, M. R., Commercial Bldg., St. Louis, Mo.
Moore, T. T., Columbia, S. C.
Moore, T. T., Jr., Columbia, S. C.
Moran, R. D., Kinsman, Ill.
Morey, A. H., Hendersonville, N. C.
Morey, C. L., Centralia, Ill.
Morgan, H. W., 211 N. High St., Nashville, Tenn.
Morgan, Owen, Johnstown, Pa.
Morgan, W. A., Camp Crook, S. D.
Morison, J. B., 14 Phillips Sq., Montreal, Que., Canada.
Morris, H. James, 451 Glossop Road, Sheffield, England.
Morris, J. D., 5247 Page Ave., St. Louis, Mo.
Morris, R. G., Olney, Ill.
Morris, R. J., Marion, Ky.
Morris, W. W., Molesworth St., Lismore, Australia.
Morrison, J. H., Connersville, Ind.
Morrison, J. S., Chester, Ill.
Morrison, P. H., Olivia Bldg., St. Louis, Mo.
Morrison, W. A., 454 Collins St., Melbourne, Australia.
Morrow, R. M., Burlington, N. C.
Morse, W. D., Pasadena, Cal.
Mosher, D. F., Bryant Bldg., Kansas City, Mo.
Moss, E. H., Chillicothe, Mo.
Moulton, L. I., Concord, N. H.
Mound, Thomas, Rutland, Vt.
Moyer, G. D., Montevideo, Minn.
Moyer, Sylvester, Galt, Ont., Canada.
Mrazek, L. W., 2522 S. 12th St., St. Louis, Mo.
Mullen, W. L., Dubuque, Ia.
Muller, H. C., Quincy, Ill.
Mullet, E. R., Clinton, Ia.
Muntz, Emanuel, 1157 Michigan St., Buffalo, N. Y.
Murdaugh, L. E., Celeste, Texas
Murdow, A. H., Winnetka, Ill.
Murphy, J. M., Temple, Texas.
Murray, W. N., Medical Blk., Minneapolis, Minn.
Musgrave, G. W., Ash Grove, Mo.
Myers, C. G., Schofield Bldg., Cleveland, Ohio.
Myers, H. H., 524 Penn Ave., Pittsburg, Pa.

N

Nance, C. L., Tampa, Fla.
Nash, B. C., 142 West 78th St., New York, N. Y.
Naumann, H. F., 503 Humphries St., Quincy, Ill.
Neel, W. E., Grant Bldg., Los Angeles, Cal.
Neeley, N. A., Christchurch, New Zealand.
Neeper, H. P., Keokuk, Ia.
Neimeter, E. L., 1113 Pine St., St. Louis, Mo.
Neuhaus, A. P., 56 Java St., The Hague, Holland.
Newcastle, C. C., Marquam Bldg., Portland, Ore.
Newkirk, Garrett, Pasadena, Cal.
Newland, C. A., Wytheville, Va.
Newsome, B., Minonk, Ill.
Nicol, J. D., Peoria, Ill.
Nicholson, J. H., Ardmore, I. T.
Nicolson, A. L., El Reno, Okla.
Nies, F. H., 37 Summit St., Brooklyn, N. Y.
Nifong, S. C., 721 N. Kings Highway, St. Louis, Mo.
Nixon, E. S., Winnfield, La.
Noble, C. C., 57 Fort St., W., Detroit, Mich.
Noble, C. S., Arroyo Grande, Cal.

Noble, J. W., Hong Kong, China.
Noel, L. G., 527½ Church St., Nashville, Tenn.
Nones, R. H., 1710 Chestnut St., Philadelphia, Pa.
Norris, R. C., Rua Direita 6, Sao Paulo, Brazil.
Norris, W. E., Charlottesville, Va.
Northrop, A. L., 57 West 49th St., New York, N. Y.
Noyes, Edmund, Stewart Bldg., Chicago, Ill.
Nugent, J. C., Altoona, Pa.
Nyce, J. E., 2320 S. Broad St., Philadelphia, Pa.

O

Oakman, C. H., 29 State St., Detroit, Mich.
O'Bryon, J. W., Lawrence, Kans.
Ohme, B. M., Alexander City, Ala.
O'Kelly, J. W., Fort Smith, Ark.
Oliver, W. G., Oconto, Wis.
O'Neil, E. S., Canton, S. D.
Ormiston, F. A., care of Bosch, Barthel & Co., Sydney, Australia.
Orr, Clark, 451 West 63rd St., Chicago, Ill.
Orr, A. W., West Newton, Pa.
Orrison, J. E., 813 N. Eutaw St., Baltimore, Md.
Orth, P. S., Monmouth, Ill.
Osterberg, Alfred, 2002 W. Superior St., Duluth, Minn.
Osterhout, C. D., Clay Center, Kan.
Otaola, Juan, Somera 51, Bilbao, Spain.
Ottofy, Louis, 50 Escolata, Manila, P. I.
Ottolengui, R., 80 West 40th St., New York, N. Y.
Owen, A., Cisco, Texas.
Owen, G. H., 3514 Lucas Ave., St. Louis, Mo.
Owens, J. R., New England Bldg., Cleveland, Ohio.
Owre, Alfred, 612 8th St., S., Minneapolis, Minn.

P

Page, A. S., Columbia, Tenn.
Page, M. J., La Crosse, Wis.
Palacios, Manuel, Plaza Santa Maria 1, Durango, Spain.
Palmer, Corydon, Warren, Ohio.
Palmer, C. M., Charles City, Ia.
Palmer, Stephen, 310 Main St., Poughkeepsie, N. Y.
Parker, C. H., 4002 Cottage Grove Ave., Chicago, Ill.
Parker, T. L., Goodman, Miss.
Parker, F. L., Johnston, S. C.
Parkhurst, C. E., 79 Walnut St., Summerville, Mass.
Parmley, M. F., Sioux City, Ia.
Parsons, Starr, 439 9th St., N. W., Washington, D. C.
Pasqueth, J. C., Mexico, Mo.
Patterson, J. D., Keith & Perry Bldg., Kansas City, Mo.
Paull, W. W., 96 W. Chippewa St., Buffalo, N. Y.
Payne, C. S., 135 Geary St., San Francisco, Cal.
Payson, W. S., Castine, Me.
Peak, J. L., Lexington, Mo.
Pearsall, W. Booth, Royal Society's Club, London, England.
Pearson, A. A., Montgomery, Ala.
Pearson, W. H., Hampton, Va.
Pease, J. G., 61 West 74th St., New York, N. Y.
Pease, J. Loran, Central Bank Bldg., San Francisco, Cal.
Peck, A. H., 92 State St., Chicago, Ill.
Peeso, F. A., 3340 Walnut St., Philadelphia, Pa.
Peirce, E. B., Monte Vista, Colo.
Pelton, R. M., 217 Woodward Ave., Detroit, Mich.
Pennington, J. A., 524 Penn Ave., Pittsburg, Pa.
Perisho, V. P., Streator, Ill.
Perry, S. G., 46 West 37th St., New York, N. Y.
Perry, J. L., Murphrysboro, Ill.
Peters, C. E., Bessemer Bldg., Pittsburg, Pa.
Peters, W. R., Box 241, Santiago, Chile.
Pettibone, J. B., Wayne Bldg., Toledo, Ohio.
Pfaff, C. P., 1655 S. Jefferson Ave., St. Louis, Mo.
Pfaff, H. V., 2217 St. Louis Ave., St. Louis, Mo.
Pfaff, J. G., 4273 Olive St., St. Louis, Mo.
Pfaff, Hofzahnarzt W., II Wienerplatz 5, Dresden, Germany.
Pfeifer, Josephine D., Masonic Temple, Chicago, Ill.
Pfluger, Moris, Esplanade 23, Hamburg, Germany.
Pherrin, J. B., Central City, Ia.
Phillips, C. A., Hastings, Neb.
Phillips, D. L., 451 West 63rd St., Chicago, Ill.
Phillips, H. H., 109 Garfield Place, Cincinnati, Ohio.

Phillips, J. T., Livingston, Ala.
Pierce, J. W., Columbus, Ga.
Pierson, J. A., 224 Auburn Road, Hawthorne, Melbourne, Australia.
Pilcher, Wm., Petersburg, Va.
Pillion, H. J., 903 Main St., Hartford, Conn.
Platschick, B., 3 Rue Ventadour, Paris, France.
Platt, F. L., 809 Market St., San Francisco, Cal.
Polhamus, Agnes I., 408 Manhattan Ave., New York, N. Y.
Pont, A., 9 Rue President Carnot, Lyons, France.
Pope, E. H., Wellington, New Zealand.
Post, C. E., 135 Geary St., San Francisco, Cal.
Potter, W. H., 16 Arlington St., Boston, Mass.
Poundstone, G. C., 2250 Milwaukee Ave., Chicago, Ill.
Pratt, H. J., McCook, Neb.
Pratto, S. A., Cassilla 1195, Buenos Aires, A. R.
Preston, A. E., Delavan, N. Y.
Preston, C. S., Green Castle, Ind.
Price, W. A., 2238 Euclid Ave., Cleveland, Ohio.
Prickett, H. D., 3906 Easton Ave., St. Louis, Mo.
Pringle, G. W., Niagara Falls, N. Y.
Pritchett, R. A., Whitehall, Ill.
Pritchett, T. W., Whitehall, Ill.
Proseus, F. W., 238 Monroe Ave., Rochester, N. Y.
Prothero, J. H., Lake and Dearborn Sts., Chicago, Ill.
Pruden, W. H., 44 Church St., Paterson, N. J.
Pruyn, C. P., 92 State St., Chicago, Ill.
Pullen, H. A., Mooney-Brisbane Bldg., Buffalo, N. Y.
Purcell, T. E., Hewson Bldg., Kansas City, Mo.
Purnell, J. W., Guadalajara, Jalisco, Mexico.

Q

Quartermann, Ed., 30 Rue de la Lois, Brussels, Belgium.
Quattlebaum, E. G., Columbia, S. C.
Quintin, L., 49 Rue de Stassart, Brussels, Belgium.

R

Rainey, A. H., Centralia, Ill.
Rambo, L. H., Montgomery, Ala.
Ramsey, R. L., Salisbury, N. C.
Rand, H. T., Springfield, Mo.
Randall, W. M., Masonic Bldg., Louisville, Ky.
Ramsey, W. B., Hickory, N. C.
Ratcliff, A. B., Dearborn, Mo.
Rathbone, W. R., Cuero, Texas.
Rathbone, R. R., Dillon, Mont.
Rauhe, Hermann, Königsalle 4, Düsseldorf, Germany.
Rawlings, G. A., Bismarck, N. D.
Raymond, H. C., Majestic Bldg., Detroit, Mich.
Read, Emma T., San Diego, Cal.
Read, M. O., Lake Forest, Ill.
Ream, F. K., Century Bldg., St. Louis, Mo.
Redman, C. E., Peru, Ind.
Reed, C. B., 731 Kansas Ave., Topeka, Kans.
Reed, J. J., Beloit, Wis.
Reed, W. L., Mexico, Mo.
Reeves, W. T., 100 State St., Chicago, Ill.
Refsum, Jos., 123 E. 60th St., New York, N. Y.
Register, H. C., 1907 Chestnut St., Philadelphia, Pa.
Reguera, Alfredo, Calle del Seminario, Mexico City, Mexico.
Reid, J. G., 67 Wabash Ave., Chicago, Ill.
Reid, J. G., Marion, N. C.
Reidy, M. J., Mechanicsville, Ia.
Reiss, O. J., 121 Baronne St., New Orleans, La.
Reisse, E. C., 1505 S. Jefferson Ave., St. Louis, Mo.
Reitz, A. R., Evansville, Ind.
Reitz, R. B., 38 E. 61st St., New York, N. Y.
Rembert, G. W., 124 Baronne St., New Orleans, La.
Reynard, Mae, Osceola, Ia.
Reynolds, W. J., Selma, Ala.
Rhein, M. L., 38 E. 61st St., New York, N. Y.
Rich, Celia, Jackson Bldg., Nashville, Tenn.
Rich, S. L., Jackson Bldg., Nashville, Tenn.
Richards, E. S., Hope, Ark.
Richards, W. H., 417 W. Clinch Ave., Knoxville, Tenn.
Richardson, W. C., Godchaux Bldg., New Orleans, La.
Richardson, W. H., 4 Elm St., Worcester, Mass.

Richter, R. G., 128 Wisconsin St., Milwaukee, Wis.
Rickles, W. A., New Decatur, Ala.
Riggle, J. H., Sherodsville, Ohio.
Ritter, J. W., Charleston, Ill.
Rizer, G. E., Burlington, Ia.
Roach, F. E., 67 Wabash Ave., Chicago, Ill.
Robb, Malcolm, Century Bldg., St. Louis, Mo.
Roberts, E. J., Augusta, Me.
Roberts, G. A., 2 College St., Toronto, Ont., Canada.
Roberts, H. E., 1516 Locust St., Philadelphia, Pa.
Roberts, W. L., 305 Opera House Blk., Denver, Colo.
Robertson, A. S., Plaquemine, La.
Robertson, L. P., Marlin, Texas.
Robertson, T. M., Coffeyville, Kans.
Robinson, O. T., Aspen, Colo.
Robinson, W. D., Paragould, Ark.
Rodemich, Henry, 1734 Chouteau Ave., St. Louis, Mo.
Rodgers, C. W., 165 Harvard St., Boston, Mass.
Rodolph, G. W., 1115 Broadway, Oakland, Cal.
Roe, W. J., 1210 Locust St., Philadelphia, Pa.
Rogers, A. P., Fall River, Mass.
Rogers, J. R., Dillon, S. C.
Rohland, C. B., Alton, Ill.
Rojo, José J., 2a Plateros 5, Mexico City, Mexico.
Rondeau, C. W. H., 4211 St. Catherine St., Montreal, Que., Canada.
Root, J. P., Deardorf Bldg., Kansas City, Mo.
Rose, J. E., Vinton, Ia.
Rose, W. E., Okawville, Ill.
Rosenthal, C. H., Neave Bldg., Cincinnati, Ohio.
Ross, J. L., McMinnville, Tenn.
Ross, F. R., Omaha, Neb.
Ross, W. F., Ballinger Bldg., St. Joseph, Mo.
Roussel, G. A., 101 Champs Elysées, Paris, France.
Rowsey, J. E., Henderson, Tenn.
Roy, J. D., Carleton Bldg., St. Louis, Mo.
Rubbrecht, Alph., Bruges, Belgium.
Rudy, L. N., Tooele, Utah.
Ruge, J. P., 1400 N. Grand Ave., St. Louis, Mo.
Ruggles, S. D., Portsmouth, Ohio.
Rust, D. N., 1408 L St., N. W., Washington, D. C.
Rutledge, Brooks, Florence, S. C.
Rutledge, W. T., Monroe City, Mo.

S

Sager, J. P., 3700 Hamilton St., Philadelphia, Pa.
Sameh, Mohammed, Cairo, Egypt.
Saner, A. W., Century Bldg., St. Louis, Mo.
Sanger, R. M., East Orange, N. J.
Sarrazin, J. J., Godchaux Bldg., New Orleans, La.
Saunders, L. P., Pawnee, Okla.
Sauvez, E., 17 Rue de St. Petersbourg, Paris, France.
Savage, G. E., 518 Main St., Worcester, Mass.
Sawyer, A. J., Manchester, N. H.
Sawyer, C. B., Jacksonville, Ill.
Schaeffer-Stuckert, Zahnarzt, Neue Zeil 62, Frankfurt a-M., Germany.
Schamberg, M. I., 1636 Walnut St., Philadelphia, Pa.
Scherer, W. H., Houston, Texas.
Scherzinger, A., 3434 Montana St., St. Louis, Mo.
Scheuer, Arthur, Vienna, Austria.
Schleef, Claire B., 2948 Washington Ave., St. Louis, Mo.
Schlegel, G. S., 147 N. 8th St., Reading, Pa.
Schlinkmann, J. H., 1007 Madison Ave., Baltimore, Md.
Schloendorn, F. W., 522 N. Charles St., Baltimore, Md.
Schlottman, E. L., Chamber of Commerce, Rochester, N. Y.
Schlueter, J. A., Jr., Aberdeen, S. D.
Schmidt, José, Rio de Janeiro, Brazil.
Schmitt, R. L., Waxahachie, Texas.
Schnarr, N., Rat Portage, Ont., Canada.
Schreier, Emil, IX Kolingasse 1, Vienna, Austria.
Schroeder, Hermann, Griefswald, Germany.
Schuck, Jacob, 939 Hickory St., St. Louis, Mo.
Schwartz, G. W., 39 E. 47th St., Chicago, Ill.
Schwartz, Geo., Jerseyville, Ill.
Schwind, W. E., Vandalia, Ill.
Schycker, M., 2459 Wentworth Ave., Chicago, Ill.
Scott, B. C., Winona, Miss.
Scott, W. C., Lansford, Pa.
Searcy, B. S., Tuscaloosa, Ala.
Searl, A. C., Owatonna, Minn.
Seeger, C. H., Manitowoc, Wis.

Seibel, R. M., Commerce Bldg., Kansas City, Mo.
Seip, Howard S., Allentown, Pa.
Selsor, W. L., Shelbina, Mo.
Semans, H. M., 289 East State St., Columbus, Ohio.
Sevilla, Castor, Bilbao, Spain.
Shafer, Leroy, Grove City, Pa.
Shattuck, G. S., 539 4th Ave., Detroit, Mich.
Shea, Mable E., 319 N. Grand Ave., St. Louis, Mo.
Shea, W. H., 4722 Cottage Ave., St. Louis, Mo.
Sheckter, S. J., 1849 Madison Ave., New York, N. Y.
Shellhorn, A. L., Kennett, Mo.
Shepard, L. D., 330 Dartmouth St., Boston, Mass.
Shewmaker, J. E., Chanute, Kan.
Shields, N. T., 61 West 56th St., New York, N. Y.
Shoening, W. H., Hilo, Hawaii.
Shoop, C. V., Central City, Colo.
Shotwell, F. A., Rogersville, Tenn.
Shryock, W. W., 27 W. Berry St., Ft. Wayne, Ind.
Siefkin, C. W., Rolfe, Ia.
Simms, S. C., Sterling, Ill.
Simons, Benjamin, 93 Broad St., Charleston, S. C.
Simpson, C. O., 4237 Olive St., St. Louis, Mo.
Simpson, O. H., Dodge City, Kans.
Simpson, R. L., Fincastle, Va.
Simpson, R. S., 111 Stanley St., Montreal, Que., Canada.
Sims, W. P., Jackson Bldg., Nashville, Tenn.
Sinton, W. K., Colorado Springs, Colo.
Sitherwood, G. D., 118 Washington St., Bloomington, Ill.
Skalstad, C. A., 843 W. Division St., Chicago, Ill.
Skeen, P. A., Texarkana, Texas.
Slabaugh, F. W., New York Life Bldg., Omaha, Neb.
Slack, W. M., 313 Main St., Memphis, Tenn.
Slater, W. K., Empire Bldg., Knoxville, Tenn.
Slonaker, J. W., 100 State St., Chicago, Ill.
Smedley, W. P., California Bldg., Denver, Colo.
Smiley, R. M., Washington, Ind.
Smith, B. Holly, 1007 Madison Ave., Baltimore, Md.
Smith, C. H., Miller Bldg., Chattanooga, Tenn.
Smith, C. Stanley, 142 E. 4th St., Cincinnati, Ohio.
Smith, D. D., 1629 Walnut St., Philadelphia, Pa.
Smith, Elwood, Mt. Vernon, Ind.
Smith, E. E., Plainview, Minn.
Smith, Eugene H., 283 Dartmouth St., Boston, Mass.
Smith, F. M., 21 E. 4th St., Chester, Pa.
Smith, Frank L., 522 Mack Blk. Denver, Colo.
Smith, G. Marshall, 1009 Madison Ave., Baltimore, Md.
Smith, G. W., Virginia, Ill.
Smith, H. A., 116 Garfield Place, Cincinnati, Ohio.
Smith, H. T., 116 Garfield Place, Cincinnati, Ohio.
Smith, J. K., Zanesville, Ohio.
Smith, J. Allen, Colorado Springs, Colo.
Smith, L. A., Port Gibson, Miss.
Smith, M. C., 3 Lee Hall, Lynn, Mass.
Smith, W. P., 948 Central Ave., Cleveland, Ohio.
Smith, W. C., Jefferson, Ga.
Smith, W. R., Pawnee City, Neb.
Smith, W. W., 63 East Ave., Rochester, N. Y.
Smoots, J. W., Beresford. S. D.
Snell, Henderson, Washington, N. C.
Solusberg, A. S., Sioux City, Ia.
Sone, W. J., Jefferson City, Mo.
Sonntag, A. F., Waco, Texas.
Sookne, Jos., 202 East Broadway, New York, N. Y.
Sorber, O. M., care of Surgeon-General, U. S. Army, Washington, D. C.
Sparks, F. D., Ponca City, Okla.
Sparks, F. M., Rushville, Ind.
Spaulding, E. B., 4 Adams Ave., Detroit, Mich.
Stadlinger, C. H., 169 N. Pearl St., Buffalo, N. Y.
Stahl, F. M., Sheridan, Wyo.
Stamm, A. P., 1400 N. Grand Ave., St. Louis, Mo.
Stanley, N. A., New Bedford, Mass.
Stanton, F. L., 35 West 38th St., New York, N. Y.
Staples, G. S., Sherman, Texas.
Staples, G. W., Dallas, Texas.
Starr, A. R., 8 E. 92nd St., New York, N. Y.

Staudinger, B., 3556 Lindell Ave., St. Louis, Mo.
Stellwagen, T. C., 1328 Chestnut St., Philadelphia, Pa.
Stemmler, L. A., 4637 Easton Ave., St. Louis, Mo.
Stephan, J. F., 129 Euclid Ave., Cleveland, Ohio.
Stern, David, 108 Garfield Place, Cincinnati, Ohio.
Stern, M., Hotel Francia é Inglaterra, Lima, Peru.
Sterpenick, Dr., Brussels, Belgium.
Steuerwald, C. A., St. Ansgar, Ia.
Stevens, A. B., Orlando, Fla.
Stevens, B. Q., Hannibal, Mo.
Stevenson, George, Liberty, Ind.
Stewart, A. J., Long View, Texas.
Stewart, G. B., Greenwood, Miss.
Stewart, Howard T., Scimiter Bldg., Memphis, Tenn.
Stiehl, G. F., McCormick Bldg., Salt Lake City, Utah.
Stiff, F. W., 600 E. Grace St., Richmond, Va.
Stillman, E. E., Watervliet, N. Y.
Stine, D. L., 440 Newton Claypool Bldg., Indianapolis, Ind.
Stockton, C. S., 7 Central Ave., Newark, N. J.
Stoeckley, J. A., South Bend, Ind.
Stone, W. E., Arapahoe & 17th Sts., Denver, Colo.
Strang, C. W., 1051 Main St., Bridgeport, Conn.
Strange, A. F., Litchfield, Ill.
Strange, Leonard, Marion, Ind.
Strong, H. F., Rose Bldg., Cleveland, Ohio.
Stryker, G. W., Everett, Wash.
Stuki, A. G., 505 8th Ave., New York, N. Y.
Stuttle, C. P., Century Bldg., St. Louis, Mo.
Subirana, Luis, Barquillo 14, Madrid, Spain.
Sugnet, E. L., 537 Williams St., Buffalo, N. Y.
Sullivan, H. H., Altman Bldg., Kansas City, Mo.
Summa, C. H., Ozark Bldg., St. Louis, Mo.
Summa, Richard, Oriel Bldg., St. Louis, Mo.
Summerlin, W. A., Dublin, Ga.
Summers, C. A., Frankfort, Ill.
Suriani, Philip, 141 2nd Ave., New York, N. Y.
Sutphen, H. S., 24 E. Kinney St., Newark, N. J.
Sutphin, J. L., Canmer, Ky.
Sutphin, S. S., Beckley, W. Va.
Swain, S. R., Marengo, Ia.
Swanson, A. W., Zumbrota, Minn.
Sweet, E. S., Woodbine, Ia.
Sweet, W. I., Providence, R. I.
Sweetman, J. L., Manistee, Mich.
Swing, R. H. D., 703 N. 40th St., Philadelphia, Pa.
Syckes, S. L., 100 Baltimore St., Cumberland, Md.

T

Taggart, W. H., Masonic Temple, Chicago, Ill.
Talbot, E. S., 103 State St., Chicago, Ill.
Talbot, W. O., Biloxi, Miss.
Talbott, R. W., 1323 G St., N. W., Washington, D. C.
Tanner, P. E., Shreveport, La.
Tavel, C. A., 337 Main St., Memphis, Tenn.
Taves, John T., Rua d'Assemblea 33, Rio de Janeiro, Brazil.
Taylor, C. R., Streator, Ill.
Taylor, G. G., Chase City, Va.
Taylor, J. L. C., 108 Dudley St., Boston, Mass.
Taylor, J. W., 108 E. 57th St., New York, N. Y.
Taylor, R. T., 337 E. 4th St., Cincinnati, Ohio.
Taylor, W. J., Sacramento, Cal.
Taylor, W. S., De Land, Fla.
Tefft, C. R., 1127 O St., Lincoln, Neb.
Temm, W. B., 1107 N. Grand Ave., St. Louis, Mo.
Terry, C. S., Columbus Memorial Bldg., Chicago, Ill.
Teufert, J. F., Graysville, O.
Thomas, J. D., 1122 Walnut St., Philadelphia, Pa.
Thompson, A. H., 720 Kansas Ave., Topeka, Kans.
Thompson, C. N., 3017 Michigan Ave., Chicago, Ill.
Thompson, H. C., 1113 Pennsylvania Ave., N. W., Washington, D. C.
Thompson, J. M., Shurley Bldg., Detroit, Mich.
Thompson, J. W., Humbolt, Tenn.
Thomson, D. P., Gaffney, S. C.
Thorpe, Burton Lee, 3666 Olive St., St. Louis, Mo.

Tignor, E. P., care Surgeon-General, U. S. Army, Washington, D. C.
Tileston, H. B., Equitable Bldg., Louisville, Ky.
Tillotson, C. H., Mattoon, Ill.
Tison, G. B., Gainesville, Fla.
Todd, J. A., 4109 Manchester Ave., St. Louis, Mo.
Toplif, C. L., Decorah, Ia.
Topping, J. B., Ottawa, Kans.
Torrence, L. B., Chester, Ill.
Totwen, S., St. Petersburg, Russia.
Towner, J. D., Lyceum Bldg., Memphis, Tenn.
Towns, W. A., Pierce City, Mo.
Tracy, W. D., 46 West 37th St., New York, N. Y.
Traynham, R. C., Pittsburg, Texas.
Trestain, C. W., Battle Creek, Mich.
Trigger, T. C., St. Thomas, Ont., Canada.
Tripp, E. A., Hooper Bldg., Salt Lake City, Utah.
Trueman, Wm. H., 900 Spruce St., Philadelphia, Pa.
Truesdell, D. M., Roodhouse, Ill.
Truex, W. E., Freehold, N. J.
Truman, James, 4505 Chester Ave., Philadelphia, Pa.
Tucker, E. J., Roxboro, N. C.
Tuller, R. B., 100 State St., Chicago, Ill.
Turner, C. R., Dental Hall, U. of P., Philadelphia, Pa.
Turner, Pitt S., Belton, Texas.
Turner, R. C., Caldwell, Kans.
Turner, V. E., Raleigh, N. C.
Tuttle, M. H., Montgomery, Ala.

V

Valdés, Téofilo G., 2a Plateros 8, Mexico City, Mexico.
Van Berg, G. W., Charles City, Ia.
Vance, M. E., 1222 O St., Lincoln, Neb.
Van de Grift, D. D., 2954 Prairie Ave., Chicago, Ill.
Van Fossen, C. L., New Bridge Bldg., Kansas City, Mo.
Vann, Geo. S., Gadsden, Ala.
Van Orden, G. N., 135 Geary St., San Francisco, Cal.
Van Orden, Leander, 606 Sutter St., San Francisco, Cal.
Van Peen, L., Gand, Belgium.
Van Stratum, F. G., Hurley, Wis.
Varley, E. W., Pueblo, Colo.
Vaughan, R. R., Century Bldg., St. Louis, Mo.
Vedder, N. D., Carrollton, Ill.
Vichot, M., 6 Rue de la Bare, Lyons, France.
Vickers, E. W., 181 Enmore Road, Enmore, Australia.
Vidaurre, Benjamin, Rivas, Nicaragua.
Vignes, C. V., 830 Canal St., New Orleans, La.
Visick, H. C., Brighton, England.
Voyles, S. H., 3201 Washington Ave., St. Louis, Mo.

W

Wagner, E., Montgomery, Ala.
Waggoner, F. M., Lansing, Mich.
Wait, D. J., Helena, Mont.
Wait, J. E., Superior, Neb.
Walker, P. P., Brandon, Miss.
Walker, W. E., 157 Baronne St., New Orleans, La.
Walker, W. G., Milan, Tenn.
Wall, A. C., Honolulu, Hawaii.
Wallace, J. F., Canton, Mo.
Wallace, J. R., 750 3rd St., Louisville, Ky.
Wallace, S. E., La Belle, Mo.
Wallick, A. L., Shreveport, La.
Walter, J. A., McGregor, Ia.
Walters, A. E., Denison, Texas.
Waltz, A. S., Decatur, Ill.
Waltz, J. F. F., Decatur, Ill.
Ward, C. A., Clarington, Ohio.
Warnekros, Ludwig, Unter den Linden 54, Berlin, Germany.
Warner, C. B., Avon, Ill.
Warner, E. R., California Bldg., Denver, Colo.
Warner, G. R., Grand Junction, Colo.
Warren, F. L., Painesville, Ohio.
Warren, G. W., 1619 Walnut St., Philadelphia, Pa.
Wassall, J. W., Stewart Bldg., Chicago, Ill.
Waters, T. S., Madison and Eutaw Sts., Baltimore, Md.
Watkins, E. C., Jefferson City, Okla.
Watkins, G. B., Whitney Bldg., Detroit, Mich.
Watkins, J. C., Winston-Salem, N. C.
Watkins, S. C. G., Montclair, N. J.
Watrous, A. S., Kewaunee, Wis.
Watson, A. C., Masonic Bldg., Denver, Colo.
Watson, G. H., Pariser Platz 7, Berlin, Germany.

Watson, M. T., 270 Woodward Ave., Detroit, Mich.
Watts, C. V., 336 Rothwell Blk., Des Moines, Iowa.
Wayland, E. A., Breckenridge, Mo.
Weatherwax, W. J., Peoria, Ill.
Weber, Andres G., Corrales la altos. Havana, Cuba.
Weber, I. R., Padro 34½. Havana. Cuba.
Webster, A. E., 3 College St., Toronto, Ont., Canada.
Wedelstaedt, E. K., New York Life Bldg., St. Paul, Minn.
Wehrenberg, W. D., 210 Lenox Ave., New York, N. Y.
Weichselbaum, William, 102 Gordon St., Savannah, Ga.
Weirick, J. E., 138 E. 6th St., St. Paul, Minn.
Weiser, Rudolph, IX Frankgasse 2, Vienna, Austria.
Weisz, Max, Vienna, Austria.
Wells, F. P., Clarinda, Ia.
Wells, J. A., Shawnee, Okla.
Wells, J. O., Masonic Temple, Minneapolis. Minn.
Wells, W. D., Commercial Bank Bldg., Macon, Ga.
Welsh, R. H., Godchaux Bldg., New Orleans, La.
Wentworth, E. P., 419 Boylston St., Boston. Mass.
West, C. H., Farina, Ill.
West. G. N., 100 State St., Chicago, Ill.
Westbay. H. E., 219 West 71st St., New York, N. Y.
Westhoff. G. H., Olivia Bldg., St. Louis, Mo.
Weston, May, Rialto Bldg., Kansas City. Mo.
Whalen. W. F., Peoria, Ill.
Wheat, S. C., Altman Bldg., Kansas City, Mo.
Wherritt, H. S., Joplin, Mo.
Wherry. S. W., Ogden, Utah.
Whipple, W. L., Missouri Trust Bldg., St. Louis, Mo.
Whitby. T. P., Selma. Ala.
White. C. L., Oklahoma City. Okla.
White, Gordon, 610½ Church St., Nashville, Tenn.
White. W. A., Phelps. N. Y.
Whiteman, J. D., Mercer, Pa.
Whitfield, G. W., Evanston, Ill.
Whitman, A. B., Orlando, Fla.
Whitmarsh, H. D., Binghamton, N. Y.
Whitmore, C. E., Portland. Mich.
Whitney, J. M., Honolulu, Hawaii.
Whitsitt, W. G., Lebanon, Tenn.
Whitslar, W. H., Schofield Bldg., Cleveland, Ohio.
Wick, J. W., Columbia Bldg., St. Louis, Mo.
Wieser, F. J., 2004 E. Grand Ave., St. Louis, Mo.
Wiggins, F., Oliver Springs, Tenn.
Wilder, F. R., 628½ 4th St., Louisville, Ky.
Williams, A. A., Columbus, Ga.
Williams, F. H., Katonah, N. Y.
Williams, J. L., 4 Walnut St., Boston, Mass.
Williams, J. Leon, 30 George St., Hanover Sq., London, W., England.
Williams, O. H., Springfield, S. D.
Williams, Samuel, 4149 W. Belle Place, St. Louis, Mo.
Williams, W. S., Shawneetown, Ill.
Wilson, Geo. H., Schofield Bldg., Cleveland, Ohio.
Wilson. H. R. C., Cleveland, Ohio.
Wilson, O. W., Carrollton, Ill.
Wilson. Robert, Arapahoe, Okla.
Wilson. R. B., 107 E. 6th St., St. Paul. Minn.
Wilson, W. C., Huntingdon, Pa.
Windhorst, M. R., 3518 Morgan St., St. Louis, Mo.
Windsor. C. D., 86 Weybosset St., Providence. R. I.
Winner. J. M., 605 King St., Wilmington, Del.
Winter, G. B., 2229 S. Broadway, St. Louis. Mo.
Witmer, E. A., Adel, Ia.
Woelk. E. A., Jr., Belleville, Ill.
Wolff, A. S., 2100 N. 11th St., St. Louis. Mo.
Womack. C. T., Martinsville. Va.
Wood. C. P., Shurley Bldg., Detroit. Mich.
Woodbury. C. E., Council Bluffs, Ia.
Woodward, J. A., 1310 Spruce St., Philadelphia. Pa.
Woodward, J. E., Macheca Bldg., New Orleans. La.
Woolfolk. E. S., Troy, Mo.
Woolsey, Walter, Elizabeth, N. J.
Worboys, C. H., Albion. Mich.
Work. C. M., Ottumwa, Ia.
Worth, C. E., Stevenson Bldg., Indianapolis, Ind.
Wright. C. H., 34 Washington St., Chicago, Ill.
Wright, J. J., Wells Bldg., Milwaukee, Wis.

WRIGHT, P. H., Oxford, Miss.
WRIGHT, T. B., Hattiesburg, Miss.
WRIGHT, W. H., Brandon, Vt.
WRIGHT, W. R., Jackson, Miss.
WYATT, T. M., Bentonville, Ark.
WYCHE, J. E., Greensboro, N. C.
WYCKOFF, W. T., Perry Bldg., Philadelphia, Pa.
WYMAN, A. F., New Bedford, Mass.

Y

YATES, D. M., Rock Mills, Ala.
YEARGAIN, G. W., 4637 Easton Ave., St. Louis, Mo.
YELA, JOAQUIN, JR., Legation de Guatemala, 2 Stone St., New York, N. Y.
YORKER, F. V., 46 43rd St., Chicago, Ill.
YOUNG, J. L., 425 Hurlbut Ave., Detroit, Mich.
YOUNG, L. A., 4661 Maryland Ave., St. Louis, Mo.
YOUNG, N. C., 215 S. Franklin St., Wilkesbarre, Pa.
YOUNG, O. M., Marion, Ohio.
YOUNG, R. C., Anniston, Ala.
YOUNG, W. B., Jacksonville, Ill.
YOUNKIN, A. E., Laredo, Texas.

Z

ZEIDLER, E. J., 1026 Esplanade Ave., New Orleans, La.
ZELENKA, R. L., Houma, La.
ZETER, W. A., 19 E. Daniel St., Cincinnati, Ohio.
ZINN, F. H., 100 State St., Chicago, Ill.
ZSIGMONDY, OTTO, I Landesgerrichtsstr. 12, Vienna, Austria.

LIST OF MEMBERS.

II. Names Arranged by Countries.

Argentine Republic.

Mathiason, C., Calle Florida 293, Buenos Aires.

Pratto, Salvador A., Casilla 1195, Buenos Aires.

Australia.

Burne, A., 1 Lyons Terrace, Liverpool St., Sydney.

Greenwell, G. S. S., Aldworth, Fenton Road, Summer Hill, Sydney.

Greenwell, H. R., Aldworth, Fenton Road, Summer Hill, Sydney.

Hall, Charles, Blue St., North Sydney.

Hough, W. C. P., 193 Macquarie St., Sydney.

McDonald, A. B., Enmore Terminus, Sydney.

Morris, W. W., Molesworth St., Lismore.

Morrison, W. A., 454 Collins St., Melbourne.

Ormiston, F. A., care of Bosch, Barthel & Co., Sydney.

Pierson, J. A., 224 Auburn Road, Hawthorne, Melbourne.

Vickers, E. W., 181 Enmore Road, Enmore.

Austria.

Bastyr, Alfred, Graben 30, Prague.

Kraus, Moritz, X Keplerplatz 1, Vienna.

Scheuer, Arthur, Vienna.

Schreier, Emil, IX Kolingasse 1, Vienna.

Weiser, Rudolph, IX Frankgasse 2, Vienna.

Weisz, Max, Vienna.

Zsigmondy, Otto, I Landesgerrichtsstr. 12, Vienna.

Belgium.

Baruch, J., 6 Rue de Berlaimont, Brussels.

Quartermann, Ed., 30 Rue de la Lois, Brussels.

Quintin, L., 49 Rue de Stassart, Brussels.

Rubbrecht, Alph., Bruges.

Sterpenick, Dr., Brussels.

Van Peen, L., Gand.

Brazil.

Houston, J. F., Rua Gonsalves Dias 2, Rio de Janeiro.

Keyes, Carlos, Rua Gonsalves Dias 2, Rio de Janeiro.

Norris, Robert C., Rua Direita 6, Sao Paulo.

Schmidt, José, Rio de Janeiro.

Taves, John T., Rua d'Assemblea 33, Rio de Janeiro.

Canada.

Abbott, H. R., 402½ Richmond St., London, Ont.

Bouche, L. F., Winnipeg, Manitoba.

Cabbage, E. V., Bonanza, Yukon Ter.

Cameron, G. S., Beaver Hall Hill, Montreal, Que.

Dubeau, Eudore, 396 St. Denis St., Montreal, Que.

Fournier, J. N. P., St. Hyacinthe, Que.

Garland, J. A., Alexandria, Ont.

Gendreau, J. G. A., 22 St. Lawrence St., Montreal, Que.

Godsoe, F. A., 74 King St., St. John, N. B.

Gowan, W. C., Creemore, Ont.

Gravelle, A. W., 749 St. Catherine St., Montreal, Que.

Magee, J. M., St. John, N. B.

Morison, J. B., 14 Phillips Sq., Montreal, Que.

Moyer, Sylvester, Galt, Ont.

Roberts, G. A., 2 College St., Toronto, Ont.

Rondeau, C. W. H., 4211 St. Catherine St., Montreal, Que.

Schnarr, N., Rat Portage, Ont.
Simpson, R. S., 111 Stanley St., Montreal, Que.
Trigger, T. C., St. Thomas, Ont.
Webster, A. E., 3 College St., Toronto, Ont.

Chile.

Cienfuegos, Mariano Ureta, Casilla 111, Santiago.
Peters, W. R., Box 241, Santiago.

China.

Ivy, Robert S., 17a The Bund, Shanghai.
Noble, J. W., Hong Kong.

Cuba.

Bazan, V. de Zayas, Obispo 75 altos, Havana.
Weber, Andres G., Corrales 1a altos, Havana.
Weber, I. R., Padro 34½, Havana.

Egypt.

Lenty, Arthur, Alexandria.
Love, J. F., Rue Nabi Daniel, Alexandria.
Sameh, Mohammed, Cairo.

England.

Brunton, George, 16 Blenheim Terrace, Woodhouse Lane, Leeds.
Campion, Geo. G., 264 Oxford Road, Manchester.
Caush, D. E., 63 Grand Parade, Hove, Brighton.
Davenport, Kirk A., 20 Stratford Place, London.
Gartrell, J. H., 47 Chapel St., Penzance, Cornwall.
Hall, Willard, 15 Saville Row, London, W.
Harrison, Walter, 6 Brunswick Place, Hove, Brighton.
Holden, J. A., Lincoln.
Lodge, A., 63 Salford, Lockwood, Huddersfield, Yorkshire.
Mitchell, L. J., 39 Upper Brook St., Grosvenor Square, London.
Mitchell, Wm., 39 Upper Brook St., Grosvenor Square, London.
Morris, H. James, 451 Glossop Road, Sheffield.
Pearsall, W. Booth, Royal Society's Club, London.
Visick, H. C., Brighton.
Williams, J. Leon, 30 George St., Hanover Square, London, W.

France.

Amoëdo, Oscar, 15 Ave. de l'Opera, Paris.
Davenport, I. B., 30 Ave. de l'Opera, Paris.
Davenport, W. S., 30 Ave. de l'Opera, Paris.
Du Bouchet, C., 37 Boulevard Malesherbes, Paris.
Frisbie, E., Nice.
Gires, Paul, 4 Rue de Rome, Paris.
Godon, Ch., 40 Rue Vignon, Paris.
Guerin, E., Moulins, Alliers.
Martin, Fr., 30 Rue de la République, Lyons.
Michaels, J. P., 24 Rue Royale, Paris.
Platschick, B., 3 Rue Ventadour, Paris.
Pont, A., 9 Rue Président Carnot, Lyons.
Roussel, G. A., 101 Champs Elysées, Paris.
Sauvez, E., 17 Rue de St. Pétersbourg, Paris.
Vichot, M., 6 Rue de la Bare, Lyons.

Germany.

Bödecker, C. F. W., Unter den Linden 54, Berlin.
Calais, Pierre, Hohenbleichen 17, Hamburg.
Hecht, Hans, Bellevuestr. 18, Berlin.
Hoffendahl, Kurt, Schellingstr. 16, Berlin.
Jenkins, N. S., Walpurgisstr. 15, Dresden.
Martin, George, Victoriastr. 10, Berlin.
Miller, W. D., Kurfürstendamm 232, Berlin.
Mohring, C. T., Neuerwall 14, Hamburg.
Pfaff, W., 11 Weinerplatz 5, Dresden.
Pfluger, Moris, Esplanade 23, Hamburg.
Rauhe, Hermann, Königsalle 4, Düsseldorf.
Schaeffer-Stuckert, Zahnarzt, Neue Zeil 62, Frankfurt a-M.
Schroeder, Hermann, Griefswald.
Warnekros, Ludwig, Unter den Linden 54, Berlin.
Watson, G. H., Pariser Platz 7, Berlin.

Guatemala.

*Yela, Joaquin, Jr., Legation of Guatemala, 2 Stone St., New York, N. Y.

Holland.

Bruske, J. S., Amsterdam.
Grevers, J. E., 13 Oude Turf Markt, Amsterdam.
Newhaus, A. P., 56 Java St., The Hague.

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* Not in attendance.

India.

Egbert, J. W., Bramley Villa, Ootacamund, Nilgiris.

Italy.

Guerini, Vincenzo, 207 Riviera di Chiaia, Naples.
Mela, Rosilino, Genoa.
Melia, Fillippo, Naples.

Java.

Anema, Rene, Batavia.

Mexico.

Contris, W. W., La Independencia 16, Mexico City.
Crombe, Ricardo, Calle de Medinas 20, Mexico City.
Falero, Juan, Callejon del Espiritu Santo 14, Mexico City.
Figueroa, Ricardo, Santo Domingo 8, Mexico City.
Keller, W. H., San Juan de Latran 4, Mexico City.
Purnell, J. W., Guadalajara, Jalisco.
Reguera, Alfredo, Calle del Seminario, Mexico City.
Rojo, José J., 2a Plateros 5, Mexico City.
Valdés, Téofilo G., 2a Plateros 8, Mexico City.

New Zealand.

Collins, T. J., Princes St., Dunedin.
Davies, O. V., Dunedin.
Neeley, N. A., Christchurch.
Pope, E. H., Wellington.

Nicaragua.

Vidaurre, Benjamin, Rivas.

Norway.

Christiansen, E. G., Drammen.
Evenson, J. E., Christiania.
Hendricksen, R., Christiania.
Kaas, Carl, 16 Universitetsgade, Christiania,

Peru.

Stern, M., Hotel Francia é Inglaterra, Lima.

Russia.

Klingelhoefer, O., 9 Morskaja, St. Petersburg.
Komodsinsky, Mme. S. Vongl, St. Petersburg.
Totwen, S., St. Petersburg.

Spain.

Aguilar, Florestan, Serrano 5, Madrid.
Baca, Antonio, Marquis de Larios 5, Malaga.
Losada, J. D., Barquillo 5, Madrid.
Otaola, Juan, Somera 51, Bilbao.
Palacios, Manuel, Plaza Santa Maria 1, Durango, Vizcaya.
Sevilla, Castor, Bilbao.

Sweden.

Förberg, Elof, 24 Sturegatan, Stockholm.

Switzerland.

Bryan, L. C., 1 St. Albananlage, Basel.

Syria.

Arbeely, G. H., Damascus.

UNITED STATES OF AMERICA.

ALABAMA.

Barr, H. D., Anniston.
Boyd, C. L., Montgomery.
Boyd, H. D., Jr., Troy.
Collins, C. C., Athens.
Corley, J. P., Greensboro.
Ellard, J. A., Birmingham.
Eubank, George, Birmingham.
Garside, W. O., Montgomery.
Hall, J. A., Collinsville.
Hassell, H. C., Tuscaloosa.
Irvin, R. E. D., Anniston.
McAnnally, F. H., Jasper.
Ohme, B. M., Alexander City.
Pearson, A. A., Montgomery.
Phillips, J. T., Livingston.
Rambo, L. H., Montgomery.
Reynolds, W. J., Selma.
Rickles, W. A., New Decatur.
Searcy, B. S., Tuscaloosa.
Tuttle, M. H., Montgomery.
Vann, Geo. S., Gadsden.

Wagner, E., Montgomery.
Whitby, T. P., Selma.
Yates, D. M., Rock Mills.
Young, R. C., Anniston.

ARKANSAS.

Andrews, J. E., Harrison.
Crume, A. L., Augusta.
Holland, A. D., Newport.
Hopkins, H. P., Little Rock.
Long, E. A., Forrest City.
Milam, T. M., Little Rock.
O'Kelly, J. W., Fort Smith.
Richards, E. S., Hope.
Robinson, W. D., Paragould.
Wyatt, T. M., Bentonville.

CALIFORNIA.

Acheson, N. B., San Diego.
Aschina, T., 374 Sutter St., San Francisco.
Atwater, H. G., 1920 E. 4th St., Los Angeles.
Cave, Daniel, Lankersheim Bldg., Los Angeles.
Chappell, H. G., Central Bank Bldg., Oakland.
Daniels, G. E., 843 Hyde St., San Francisco.
Davis, H. S., 595 Geary St., San Francisco.
Dewey, J. S., Alturas.
Dodel, X., 1307 Howard St., San Francisco.
Flood, A. M., 927 Market St., San Francisco.
Ford, L. E., 12 Muskegon Blk., Los Angeles.
*Goddard, C. L., 406 Sutter St., San Francisco.
Gothard, J. T., Alturas.
Graham, L. E., Sacramento.
Griner, O. T., Lakeport.
Hackett, F. M., 413 Leavenworth St., San Francisco.
Harndon, F. W., 135 Geary St., San Francisco.
Hart, C. E., California Bldg., San Francisco.
Hodgen, J. D., 1005 Sutter St., San Francisco.
Iglehart, T. N., 725 Sutter St., San Francisco.
James, E. P., 121 Geary St., San Francisco.
Jones, L. D., San Diego.
Jones, L. G., 618 Logan Ave., San Diego.
Knox, H. B., 1111 Washington St., Oakland.
Locke, F. H., 1406 11th St., Oakland.
Loring, E. L., West Berkeley.
McAlpine, A. C., San Diego.
McCowen, W., Ukiah.
Mathiason, P. B., Los Angeles.
Merriman, A. F., 1114 Washington St., Oakland.
Miller, O. L., 252 Scott St., San Francisco.
Morse, W. D., Pasadena.
Neel, W. E., Grant Bldg., Los Angeles.
Newkirk, Garrett, Pasadena.
Noble, C. S., Arroyo Grande.
Payne, C. S., 135 Geary St. San Francisco.
Pease, J. Loran, Central Bank Bldg., San Francisco.
Platt, F. L., 809 Market St., San Francisco.
Post, C. E., 135 Geary St., San Francisco.
Read, Emma T., San Diego.
Rodolph, G. W., 1115 Broadway, Oakland.
Taylor, W. J., Sacramento.
Van Orden, G. N., 135 Geary St., San Francisco.
Van Orden, Leander, 606 Sutter St., San Francisco.

COLORADO.

Bagley, C. H., 1132 15th St., Denver.
Brierley, W. A., 70 Barth Blk., Denver.
Brown, O. W., El Paso Bldg., Denver.
Carmody, T. E., Masonic Bldg., Denver.
Cattermole, F. P., Boulder.
Chambers, W. T., California Bldg., Denver.
Clark, H. T., Longmont.
Delbridge, W. H., Greeley.
Fullerton, L. K., 423 Mack Blk., Denver.
Fynn, H. A., California Bldg., Denver.
Harrison, B. T., 44 Barth Blk., Denver.
Hoffman, H. F., California Bldg., Denver.
Howell, J. L., Creede.
Hubbell, C. R., La Junta.
Hurst, L. D., 619 Mack Blk., Denver.
Jackson, J. S., California Bldg., Denver.
Ketcham, A. H., Masonic Bldg., Denver.
McKay, F. S., Colorado Springs.
Mercer, C. L., 722 14th St., Denver.
Peirce, E. B., Monte Vista.
Roberts, W. L., 305 Opera House Blk., Denver.
Robinson, O. T., Aspen.
Shoop, C. V., Central City.
Sinton, W. K., Colorado Springs.
Smedley, W. P., California Bldg., Denver.
Smith, Frank L., 522 Mack Blk., Denver.
Smith, J. Allen, Colorado Springs.
Stone, W. E., Arapahoe and 17th Sts., Denver.
Varley, E. W., Pueblo.
Warner, E. R., California Bldg., Denver.
Warner, G. R., Grand Junction.
Watson, A. C., Masonic Bldg., Denver.

---

*Deceased.

CONNECTICUT.

Barker, J. Tenney, Wallingford.
Beach, L. L., Bristol.
Cahill, W. H., 75 Pratt St., Hartford.
Eberle, Edward, 902 Main St., Hartford.
Gaylord, E. S., 63 Trumbull St., New Haven.
Hindsley, Frederick, 1151 Main St., Bridgeport.
McManus, Charles, 80 Pratt St., Hartford.
McManus, Henry, 80 Pratt St., Hartford.
McManus, James, 80 Pratt St., Hartford.
Pillion, H. J., 903 Main St., Hartford.
Strang, C. W., 1051 Main St., Bridgeport.

DELAWARE.

Baker, B. H., 1022 Jackson St., Wilmington.
Clifton, R. H., Smyrna.
Hitch, G. A., Laurel.
Jefferis, C. R., New Century Bldg., Wilmington.
Jones, R. H., 408 Delaware Ave., Wilmington.
Winner, J. M., 605 King St., Wilmington.

DISTRICT OF COLUMBIA.

Allen, H. Jerome, Colorado Bldg., Washington.
Brown, A. J., 1928 L St., N. W., Washington.
Bryant, E. A., 1320 New York Ave., Washington.
Carpenter, Alden, care of Surgeon-General, U. S. Army, Washington.
Cogan, W. N., The Sherman, Washington.
Cuthbertson, C. W., 309 7th St., N. W., Washington.
Davis, L. F., 1108 New York Ave., N. W., Washington.
Davis, S. G., 607 13th St., N. W., Washington.
Diedel, Charles, 1015 H St., N. W., Washington.
Dieffenderfer, W. E., The Colorado, Washington.
Donnally, Williams, 1018 14th St., N. W., Washington.
Evans, Paul W., Bond Bldg., Washington.
Finley, M. F., 1928 I St., N. W., Washington.
Lofton, W. S., 1543 M St., N. W., Washington.
London, John H., 1115 G St., N. W., Washington.
Marshall, John S., care of Surgeon-General U. S. Army, Washington.
Parsons, Starr, 439 9th St., N. W., Washington.
Rust, D. N., 1408 L St., N. W., Washington.
Sorber, O. M., care of Surgeon-General, U. S. Army, Washington.
Talbot, R. W., 1323 G St., N. W., Washington.
Thompson, H. C., 1113 Penna. Ave., N. W., Washington.
Tignor, E. P., care of Surgon-General, U. S. Army, Washington.

FLORIDA.

Anderson, H. A., Phœnix Blk., Jacksonville.
Brown, G. L., St. Petersburg.
Brush, Edith R., Daytona.
Chace, J. E., Ocala.
Driscoll, W. E., Bradentown.
Elkins, L. C., St. Augustine.
Frink, C. H., Fernandina.
Fuller, R. D., Ocala.
Kemp, C. F., Key West.
Kohly, A. J., Tampa.
Law, E. A., Bartow.
Luxmore, Wm., Mariana.
Mason, W. G., Tampa.
Nance, C. L., Tampa.
Stevens, A. B., Orlando.
Taylor, W. S., De Land.
Tison, G. B., Gainesville.
Whitman, A. B., Orlando.

GEORGIA.

Adair, Robin, Lowndes Bldg., Atlanta.
Barnwell, C. M., Inman Bldg., Atlanta.
Cramer, J. E., Carrollton.
Crenshaw, Thomas, Prudential Bldg., Atlanta.
Crenshaw, William, Prudential Bldg., Atlanta.
Exley, F. C., 202 Liberty St., Savannah.
Foster, S. W., 100 N. Butler St., Atlanta.
Gordy, A. P., Columbus.
Gowan, C. M., Brunswick.
Hall, C. T., Cochran.
Hinman, T. P., Inman Bldg., Atlanta.
Holland, Frank, Prudential Bldg., Atlanta.
Jackson, A. M., Commercial Bank Bldg., Macon.
Jewett, H. R., The Grand Bldg., Atlanta.
Johnson, H. H., Commercial Bank Bldg., Macon.
Lorenz, J. H., Inman Bldg., Atlanta.
McArthur, C. Z., Fort Valley.

Pierce, J. W., Columbus.
Smith, W. C., Jefferson.
Summerlin, W. A., Dublin.
Weichselbaum, Wm., 27 Jones St., Savannah.
Wells, W. D., Commercial Bank Bldg., Macon.
Williams, A. A., Columbus.

HAWAII.

Clark, F. E., Honolulu.
Derby, A. J., Honolulu.
Grossman, M. E., Box 744, Honolulu.
High, C. B., Honolulu.
Montaga, Tunetaro, Honolulu.
Shoening, W. H., Hilo.
Wall, A. C., Honolulu.
Whitney, J. M., Honolulu.

IDAHO.

Burns, J. B., Payette.
Cate, A. W., Boisé.
Green, G. A., Grangeville.
Lewis, J. H., Nez Perce.

ILLINOIS.

Allen, A. B., 67 Wabash Ave., Chicago.
Ames, W. V-B., 34 Washington St., Chicago.
Appel, George, 31 Washington St., Chicago.
Baker, Hester I., Quincy.
Banzet, G. T., 31 Washington St., Chicago.
Barcus, J. M., Carlinville.
Beck, Rudolph, 92 State St., Chicago.
Bellchamber, C. E., Effingham.
Bentley, C. E., 100 State St., Chicago.
Birkland, J. W., 2231 Prairie Ave., Chicago.
Black, A. D., 31 Washington St., Chicago.
Black, G. V., Lake and Dearborn Sts., Chicago.
Blair, E. K., Waverly.
Brand, L. W., Benton.
Brophy, R. C., 72 Canal St., Chicago.
Brophy, T. W., Marshall Field Bldg., Chicago.
Brown, Wm., Sumner.
Buckley, J. P., 578 W. Madison St., Chicago.
Bull, H. D., Jerseyville.
Burroughs, E. L., Edwardsville.
Campbell, S. A., Mattoon.
Carlene, H. O., 1190 Sheffield Ave., Chicago.
Carpenter, E. R., Cable Bldg., Chicago.
Carpenter, G. T., 67 Wabash Ave., Chicago.
Case, C. S., Stewart Bldg., Chicago.
Chandler, V. K., Delavan.
Cheeseman, F. E., 31 Washington St., Chicago.
Cigrand, B. J., North and Milwaukee Aves., Chicago.
Combs, H. F., Stewart Bldg., Chicago.
Condon, J. J., Effingham.
Conkey, F. M., Homer.
Conroy, J. R., Belleville.
Cook, G. W., 4700 Kenwood Ave., Chicago.
Corbett, C. C., Edwardsville.
Cormany, J. W., Mt. Carroll.
Corwin, J., 100 State St., Chicago.
Cox, Le G. M., Stockton.
Crouse, J. N., 2231 Prairie Ave., Chicago.
Cummins, J. T., Metropolis.
Davis, H. E., St. Joseph.
Dieterich, J., Carlyle.
Dittman, G. W., Apple River.
Dodge, C. H., Odin.
Dressel, H. G., 323 S. Western Ave., Chicago.
Duncan, S. F., Joliet.
Entsminger, G. W., Carbondale.
Evans, C. C., Colfax.
Evans, E. T., Decatur.
Fischer, H. G., 1240 E. Ravenswood Park, Chicago.
Foster, W. E., Danville.
Franz, H., 31 Washington St., Chicago.
Freeman, H. W., Grant Park.
Frink, J. L., Masonic Temple, Chicago.
Fuqua, Victor H., Stewart Bldg., Chicago.
Gallie, D. M., 100 State St., Chicago.
Gilmer, T. L., 31 Washington St., Chicago.
Girling, Winthrop, 31 Washington St., Chicago.
Goslee, H. J., 580 W. Madison St., Chicago.
Gramm, C. T., 103 State St., Chicago.
Green, L. O., 100 State St., Chicago.
Grisamore, T. L., 1035 W. Van Buren St., Chicago.
Gunther, H. A., 3300 Cottage Grove Ave., Chicago.
Hall, O. C., 153 53rd St., Chicago.
Hammen, E. C., Lebanon.
Harden, O. H., 722 E. 63rd St., Chicago.
Harper, W. E., 3441 Wabash Ave., Chicago.
Haskell, L. P., 34 Washington St., Chicago.
Hillier, C. W., 935 W. 63rd St., Chicago.
Hinkins, J. E., 131 E. 53rd St., Chicago.
Holland, W. E., Jerseyville.
Hollinger, O., Schiller Bldg., Chicago.
Hood, R. J., Sparta.
Hugo, C. J., Okawville.
Hume, E. J., Whitehall.

Hurlbut, C. H., Evanston.
Johnson, C. N., Marshall Field Bldg., Chicago.
Johnson, I. B., Onarga.
Johnston, W. A., Peoria.
Jones, C. E., 813 W. Harrison St., Chicago.
Jones, F. C., Greenville.
Keefe, J. E., 34 Washington St., Chicago.
Kiernan, J. G., Columbus Memorial Bldg., Chicago.
Koppreu, G. H., Jacksonville.
Krause, J. L., Eureka.
Latham, Vida A., 808 Morse Ave., Rogers Park, Chicago.
Leavitt, M. B., 4054 Indiana Ave., Chicago.
Logan, W. H. G., 31 Washington St., Chicago.
Lourie, L. S., 92 State St., Chicago.
Lowry, F. M., Delavan.
Lumpkin, I. A., Mattoon.
McIntosh, F. H., Bloomington.
McMillan, H. W., Roseville.
MaWhinney, Elgin, 34 Washington St., Chicago.
Marsh, J. W., Warsaw.
Matteson, A. E., 3900 Cottage Grove Ave., Chicago.
Meade, C. M., Carmi.
Mentze, C., Belleville.
Molt, F. F., Arcade Bldg., Pullman.
Monroe, Grafton, Springfield.
Moran, R. D., Kinsman.
Morey, C. L., Centralia.
Morris, R. G., Olney.
Morrison, J. S., Chester.
Muller, H. C., Quincy.
Murdow, A. H., Winnetka.
Naumann, H. F., 503 Humphries St., Quincy.
Newsome, B., Minonk.
Nicol, J. D., Peoria.
Noyes, Edmund, Stewart Bldg., Chicago.
Orr, Clark, 451 W. 63rd St., Chicago.
Orth, P. S., Monmouth.
Parker, C. H., 4002 Cottage Grove Ave., Chicago.
Peck, A. H., 92 State St., Chicago.
Perisho, V. P., Streator.
Perry, J. L., Murphrysboro.
Pfeiffer, Josephine D., Masonic Temple, Chicago.
Phillips, D. L., 451 W. 63rd St., Chicago.
Poundstone, G. C., 2250 Milwaukee Ave., Chicago.
Pritchett, R. A., Whitehall.
Pritchett, T. W., Whitehall.
Prothero, J. H., Lake and Dearborn Sts., Chicago.
Pruyn, C. P., 92 State St., Chicago.
Rainey, A. H., Centralia.
Read, M. O., Lake Forest.
Reeves, W. T., 100 State St., Chicago.
Reid, J. G., 67 Wabash Ave., Chicago.
Ritter, J. W., Charleston.
Roach, F. E., 67 Wabash Ave., Chicago.
Rohland, C. B., Alton.
Rose, W. E., Okawville.
Sawyer, C. B., Jacksonville.
Schwartz, Geo., Jerseyville.
Schwartz, G. W., 39 E. 47th St., Chicago.
Schwind, W. E., Vandalia.
Schycker, M., 2459 Wentworth Ave., Chicago.
Simms, S. C., Sterling.
Sitherwood, G. D., 118 Washington St., Bloomington.
Skalstad, C. A., 843 W. Division St., Chicago.
Slonaker, J. W., 100 State St., Chicago.
Smith, G. W., Virginia.
Strange, A. F., Litchfield.
Summers, C. A., Frankfort.
Taggart, W. H., Masonic Temple, Chicago.
Talbot, E. S., 103 State St., Chicago.
Taylor, C. R., Streator.
Terry, C. S., Columbus Memorial Bldg., Chicago.
Thompson, C. N., 3017 Michigan Ave., Chicago.
Tillotson, C. H., Mattoon.
Torrence, L. B., Chester.
Truesdell, D. M., Roodhouse.
Tuller, R. B., 100 State St., Chicago.
Van de Grift, D. D., 2954 Prairie Ave., Chicago.
Vedder, N. D., Carrollton.
Waltz, A. S., Decatur.
Waltz, J. F. F., Decatur.
Warner, C. B., Avon.
Wassell, J. W., Stewart Bldg., Chicago.
Weatherwax, W. J., Peoria.
West, C. H., Farina.
West, G. N., 100 State St., Chicago.
Whalen, W. F., Peoria.
Whitfield, G. W., Evanston.
Williams, W. S., Shawneetown.
Wilson, O. W., Carrollton.
Woelk, E. A., Jr., Belleville.
Wright, C. H., 34 Washington St., Chicago.
Yorker, F. V., 46 43rd St., Chicago.
Young, W. B., Jacksonville.
Zinn, F. H., 100 State St., Chicago.

INDIANA.

Adams, R. A., Clinton.
Albrecht, Maurice, 59 Ingalls Blk., Indianapolis.
Blakeman, R. L., Willoughby Bldg., Indianapolis.
Byram, J. Q., 131 E. Ohio St., Indianapolis.
Dicken, W. A., Attica.
Haas, M. M., Evansville.
Hacker, T. S., Willoughby Bldg., Indianapolis.
Hague, T. H., Huntington.
Heckard, W. A., 35 Ingalls Blk., Indianapolis.
Henshaw, F. R., Middletown.
Hulley, E. S., Marion.
Hunt, George E., 131 E. Ohio St., Indianapolis.
Kahlo, H. C., 115 E. New York St., Indianapolis.
McCurdy, J. S., 825 Harrison St., Fort Wayne.
Mason, M. A., Fort Wayne.
Morrison, J. H., Connersville.
Preston, C. S., Green Castle.
Redman, C. E., Peru.
Reitz, A. R., Evansville.
Shryock, W. W., 27 W. Berry St., Ft. Wayne.
Smiley, R. M., Washington.
Smith, Elwood, Mt. Vernon.
Sparks, F. M., Rushville.
Stevenson, George, Liberty.
Stine, D. L., 440 Newton Claypool Bldg., Indianapolis.
Stoeckley, J. A., South Bend.
Strange, Leonard, Marion.
Worth, C. E., Stevenson Bldg., Indianapolis.

INDIAN TERRITORY.

Barnes, L. L., Paul's Valley.
Cunningham, B. C., Colgate.
Day, C. W., Vinita.
Heflin, E. E., Ardmore.
Long, S. A., South McAllister.
Nicholson, J. H., Ardmore.

IOWA.

Baird, W. H., Burlington.
Ball, E. H., Tama.
Batcher, W. H., Toledo.
Begun, A. R., 522 Walnut St., Des Moines.
Booth, C. N., Cedar Rapids.
Booth, J. J., Marion.
Breene, F. T., Iowa City.
Bruner, C. W., Waterloo.
Calhoun, J. F., Birmingham.
Clack, W. R., Clear Lake.
Conzett, J. V., Dubuque.
Crandall, W. G., Spencer.
Creath, W. E., Ottumwa.
Dana, A. W., Burlington.
Daugherty, T. E., Guthrie Center.
Engel, H. S., Lineville.
Finn, Wm., Cedar Rapids.
Gary, A. G., Walker.
Goodenough, G. D., Gowrie.
Griffis, T. R., Carson.
Hagerty, R. E., Dubuque.
Hasek, A. M., Cedar Rapids.
Hildebrand, J. G., Waterloo.
Hinkley, B. C., Keokuk.
Holson, A. M., Grinnell.
Hosford, W. S., Iowa City.
Houghton, M. J., Valley Junction.
James, F. B., Wilton Junction.
Jones, P. H., Clear Lake.
Keeler, H. D., Century Bldg., Des Moines.
Kellogg, R. D., Sioux City.
Lange, H. F., Muscatine.
Lathrop, C. M., Toledo.
Long, M., Eddyville.
Madison, H. L., Burlington.
Miller, C. B., Cedar Falls.
Mullen, W. L., Dubuque.
Mullet, E. R., Clinton.
Neeper, H. P., Keokuk.
Palmer, C. M., Charles City.
Parmley, M. F., Sioux City.
Pherrin, J. B., Central City.
Reidy, M. J., Mechanicsville.
Reynard, Mae, Osceola.
Rizer, G. E., Burlington.
Rose, J. E., Vinton.
Siefkin, C. W., Rolfe.
Solusberg, Arthur S., Sioux City.
Steuerwald, C. A., St. Ansgar.
Swain, S. R., Marengo.
Sweet, E. S., Woodbine.
Toplif, C. L., Decorah.
Van Berg, G. W., Charles City.
Walter, J. A., McGregor.
Watts, C. V., 336 Rothwell Blk., Des Moines.
Wells, F. P., Clarinda.
Witmer, E. A., Adel.
Woodbury, C. E., Council Bluffs.
Work, C. M., Ottumwa.

KANSAS.

Ashby, A. L., Ottawa.
Bumgardner, Edward, Lawrence.
Burket, J. F., Kingman.
Carpenter, M. C., Portsmouth Bldg., Kansas City.
Charlson, O. O. S., Lindsburg.
Cockrill, F. M., Leavenworth.
Coston, W. A., Fort Scott.
Culbertson, George, Emporia.
Cutler, W. E., Chanute.
Esterly, G. A., Lawrence.
Ewart, A. C., Marysville.
Fessenden, H. W., Ottawa.
Hatfield, T. I., Marysville.
Hetrick, F. O., Ottawa.
Hodge, H. W., Wichita.
Hodge, L. D., Arkansas City.
Jacobson, E., Hazelton.
McCarter, W. A., 733 Kansas Ave., Topeka.
McKelvy, W. A., Atchison.
Martin, C. A., Winfield.
Miner, G. H., Hutchinson.
Mitchell, L. D., Arkansas City.
O'Bryon, J. W., Lawrence.
Osterhout, C. D., Clay Center.
Reed, C. B., 731 Kansas Ave., Topeka.
Robertson, T. M., Coffeyville.
Shewmaker, J. E., Chanute.
Simpson, O. H., Dodge City.
Thompson, A. H., 720 Kansas Ave., Topeka.
Topping, J. B., Ottawa.
Turner, R. C., Caldwell.

KENTUCKY.

Bryan, J. W., Russellville.
Burke, G. L., Owensboro.
Cassidy, J. S., Covington.
Clark, G. K., Russellville.
Clark, J. W., Courier-Journal Bldg., Louisville.
Dailey, M. H., Paris.
Dietrich, Wm., 1830 Baxter Ave., Louisville.
Doyle, B. O., 206 W. Chestnut St., Louisville.
Eble, Max M., Equitable Bldg., Louisville.
Gardner, H. J., Bardwell.
Grant, W. E., Masonic Bldg., Louisville.
Howell, I. B., Paducah.
Hubbuck, E. H., 323 4th St., Louisville.
Huffman, L. F., Lexington.
Kellogg, H. K., Equitable Bldg., Louisville.
Kettig, E. M., 318 W. Walnut St., Louisville.
Meguiar, C. W., Mumfordville.
Morris, R. J., Marion.
Randall, W. M., Masonic Bldg., Louisville.
Sutphin, J. L., Canmer.
Tileston, H. B., Equitable Bldg., Louisville.
Wallace, J. R., 750 3d St., Louisville.
Wilder, F. R., 628½ 4th St., Louisville.

LOUISIANA.

Bauer, Jos., 109 Bourbon St., New Orleans.
Bercier, A. J., Opelousas.
Cappel, C., Evergreen.
Comegys, J. M., Shreveport.
Du Puy, T. M., Alexandria.
Feltus, H. J., Baton Rouge.
Fort, A. K., Lake Charles.
Gibbons, C. N., Godchaux Bldg., New Orleans.
Grosjean, S. S., Godchaux Bldg, New Orleans.
Johnston, J. F., Ruston.
Knapp, J. Rollo, 830 Canal St., New Orleans.
Louque, G. A., 830 Canal St., New Orleans.
Nixon, E. S., Winnfield.
Reiss, O. J., 121 Baronne St., New Orleans.
Rembert, G. W., 124 Baronne St., New Orleans.
Richardson, W. C., Godchaux Bldg., New Orleans.
Robertson, A. S., Plaquemine.
Sarrazin, Jules J., Godchaux Bldg., New Orleans.
Tanner, P. E., Shreveport.
Vignes, C. V., 830 Canal St., New Orleans.
Walker, W. E., 157 Baronne St., New Orleans.
Wallick, A. L., Shreveport.
Welsh, R. H., Godchaux Bldg., New Orleans.
Woodward, J. E., Macheca Bldg., New Orleans.
Zeidler, E. J., 1026 Esplanade Ave., New Orleans.
Zelenka, R. L., Houma.

MAINE.

Bibber, W. R., Eastport.
Bryant, E. C., Pittsfield.
Chilcott, L. S., Bangor.
Fellows, D. W., Portland.
Kelley, H. A., Portland.
Leighton, C. B., Portland.
Maxfield, F. E., Bangor.
Payson, W. S., Castine.
Roberts, E. J., Augusta.

MARYLAND.

Brewer, A. C., 520 N. Charles St., Baltimore.
Burgess, J. K., 117 W. Franklin St., Baltimore.
Deichman, G. L., Madison and Howard Sts., Baltimore.
Duff, D. E., Park and Madison Aves., Baltimore.
Finney, W. B., 813 N. Eutaw St., Baltimore.
Foster, W. G., 9 W. Franklin St., Baltimore.
Gingrich, C. M., 608 St. Paul St., Baltimore.
Grady, Richard, Annapolis.
Grieves, C. J., Park and Madison Aves., Baltimore.
Hardy, George E., Madison and Howard Sts., Baltimore.
Kammer, C. W., 2123 Madison Ave., Baltimore.
Kelsey, H. E., Madison and Howard Sts., Baltimore.
LeCron, S. L., 320 N. Charles St., Baltimore.
Marchant, J. H., 314 N. Eutaw St., Baltimore.
Orrison, J. E., 813 N. Eutaw St., Baltimore.
Schlinkmann, J. H., 1007 Madison Ave., Baltimore.
Schloendorn, F. W., 522 N. Charles St., Baltimore.
Smith, B. Holly, 1007 Madison Ave., Baltimore.
Smith, G. Marshall, 1009 Madison Ave., Baltimore.
Syckes, S. L., 100 Baltimore St., Cumberland.
Waters, T. S., Madison and Eutaw Sts., Baltimore.

MASSACHUSETTS.

Allen, J. F., Campello.
Allis, D. H., Masonic Temple, Springfield.
Barrett, T. J., 492 Main St., Worcester.
Boardman, Waldo E., 184 Boylston St., Boston.
Briggs, E. C., 129 Marlboro St., Boston.
Brigham, W. I., South Framingham.
Clapp, D. M., 130 Commonwealth Ave., Boston.
Cooke, W. P., 330 Dartmouth St., Boston.
Donnelly, J. A., Fall River.
Dowsley, J. F., 175 Tremont St., Boston.
Fillebrown, Thomas, 157 Newbury St., Boston.
Flanagan, A. J., 352 Main St., Springfield.
Hardy, H. W., 129 Marlboro St., Boston.
Hinkley, F. B., Fall River.
Hopkins, S. A., 235 Marlboro St., Boston.
Kelly, J. C., Newburyport.
Libby, A. A., 687 Boylston St., Boston.
Lindstrom, C. R., 31 Exchange St., Lynn.
MacGown, W. Y., 333 Union St., Lynn.
Maxfield, G. A., 390 High St., Holyoke.
Mitchell, G. E., 25 Merrimack St., Haverhill
Moffatt, R. T., 85 Newbury St., Boston.
Parkhurst, C. E., 79 Walnut St., Summerville.
Potter, W. H., 16 Arlington St., Boston.
Richardson, W. H., 4 Elm St., Worcester.
Rodgers, C. W., 165 Harvard St., Boston.
Rogers, A. P., Fall River.
Savage, G. E., 518 Main St., Worcester.
Shepard, L. D., 330 Dartmouth St., Boston.
Smith, Eugene H., 283 Dartmouth St., Boston.
Smith, M. C., 3 Lee Hall, Lynn.
Stanley, N. A., New Bedford.
Taylor, J. L. C., 108 Dudley St., Boston.
Wentworth, E. P., 419 Boylston St., Boston.
Williams, J. L., 4 Walnut St., Boston.
Wyman, A. F., New Bedford.

MICHIGAN.

Cleland, Wm., Ferguson Bldg., Detroit.
Collins, T. J., 250 St. Antoine St., Detroit.
Dewey, M., Grand Rapids.
Dodson, S. E., Grand Rapids.
Ewart, H. E., St. Clair.
Field, G. L., 4 Adams Ave., W., Detroit.
Frumveller, E. H., Shurley Bldg., Detroit.
Hall, L. P., Ann Arbor.
Hampton, C. G., Jr., 970 Woodward Ave., Detroit.
Herbert, W. C., Whitney Bldg., Detroit.
Hines, P. F., Lake Odessa.
Hoff, N. S., Ann Arbor.
House, J. Ward, Grand Rapids.
Howlett, B. J., Ann Arbor.
Hutchins, M. C., Flint.
Jackson, H. H., 317 Jefferson Ave., Detroit.
Kendrick, M. A., Port Huron.
Land, C. H., 64 Elizabeth St., Detroit.
Lawrason, A. N., Lansing.
Le Gro, A. L., Three Rivers.
Long, A. M., Monroe.
Mackenzie, J. F., 391 Trumbull Ave., Detroit
Monroe, A. F., Flint.

Moore, E. C., 112 Miami Ave., Detroit.
Noble, C. C., 57 Fort St., W., Detroit.
Oakman, C. H., 29 State St., Detroit.
Pelton, R. M., 217 Woodward Ave., Detroit.
Raymond, H. C., Majestic Bldg., Detroit.
Shattuck, G. S., 539 4th Ave., Detroit.
Spaulding, E. B., 4 Adams Ave., W., Detroit.
Sweetman, J. L., Manistee.
Thompson, J. M., Shurley Bldg., Detroit.
Trestain, C. W., Battle Creek.
Waggoner, F. M., Lansing.
Watkins, G. B., Whitney Bldg., Detroit.
Watson, M. T., 270 Woodward Ave., Detroit.
Whitmore, C. E., Portland.
Wood, C. P., Shurley Bldg., Detroit.
Worboys, C. H., Albion.
Young, J. L., 425 Hurlbut Ave., Detroit.

MINNESOTA.

Bond, Scipio, Anoka.
Carlson, K. E., care of Surgeon-General, New York Life Bldg., St. Paul.
Cruttenden, H. L., Northfield.
Denton, H. B., Eveleth.
Dickinson, W. P., Andrus Bldg., Minneapolis.
Fawcett, A. C., Rochester.
Gallagher, J. W. S., Winona.
Havel, M. V., Montgomery.
James, W. D., Tracy.
Johnson, E. M., St. Cloud.
Kelly, J. L., Germania Life Bldg., St. Paul.
Lentz, O. A., Ryan Bldg., St. Paul.
Lewis, A. M., Austin.
Moody, F. E., 26 Syndicate Blk., Minneapolis.
Moyer, G. D., Montevideo.
Murray, W. N., Medical Blk., Minneapolis.
Osterberg, Alfred, 2002 W. Superior St., Duluth.
Owre, Alfred, 612 8th St., S., Minneapolis.
Searl, A. C., Owatonna.
Smith, E. E., Plainview.
Swanson, A. W., Zumbrota.
Wedelstaedt, E. K., New York Life Bldg., St. Paul.
Weirick, J. E., 138 E. 6th St., St. Paul.
Wells, J. O., Masonic Temple, Minneapolis.
Wilson, R. B., 107 E. 6th St., St. Paul.

MISSISSIPPI.

Askew, J. B., Vicksburg.
Campbell, T. J., Okalona.
Colbert, W. B., Ackerman.
Cotten, T. H., Carthage.
Granlof, L. D., Aberdeen.
Haynes, G. F., Newton.
Holcombe, P. D., Lexington.
Jonas, I., Brooksville.
Kelly, A. B., Yazoo City.
Luckie, R. K., Holly Springs.
McLaurin, L. B., Fayette.
Martin, W. T., Yazoo City.
Parker, T. L., Goodman.
Scott, B. C., Winona.
Smith, L. A., Port Gibson.
Stewart, G. B., Greenwood.
Talbot, W. O., Biloxi.
Walker, P. P., Brandon.
Wright, P. H., Oxford.
Wright, T. B., Hattiesburg.
Wright, W. R., Jackson.

MISSOURI.

Abbott, C. L., 1208 Wyandotte St., Kansas City.
Allen, C. C., Rialto Bldg., Kansas City.
Ambrose, W. P., 932 Beach Ave., St. Louis.
Angle, E. H., 1023 N. Grand Ave., St. Louis.
Applegate, G. W., 2602 Locust St., St. Louis.
Arthur, W. B., 3155 Shenandoah St., St. Louis.
Ashley, K. P., Deardorf Bldg., Kansas City.
Austin, J. M., 1121 Frederick St., St. Joseph.
Bartel, L. W., 2603 Cass Ave., St. Louis.
Bass, I. A., 3553 Olive St., St. Louis.
Bassett, S. T., Century Bldg., St. Louis.
Bear, E. W., Fullerton Bldg., St. Louis.
Beatie, E. L., Norborne.
Becker, Emil F., 2253 S. Jefferson Ave., St. Louis.
Behrens, F. C., Westlich Bldg., St. Louis.
Boatner, H., Springfield.
Bowles, J. D., Tipton.
Bowman, G. A., 3605 Delmar Ave., St. Louis.
Braham, J. V., Doe Run.
Brame, Frank, Windsor.
Bridgeford, J. L., Macon.
Bronson, G. A., 3201 Washington Ave., St. Louis.
Brown, W. E., Holland Bldg., St. Louis.
Burgess, R. M., Jr., Paris.
Campbell, D. D., Ozark.
Carter, W. M., Sedalia.
Cassel, H. F., 2602 Locust St., St. Louis.
Chaffee, J. B., Carthage.
Chase, Emma Eames, 3334 Washington Ave., St. Louis.

Cherry, W. W., Olivia Bldg., St. Louis.
Cleveland, W. W., Louisiana.
Coleman, C. B., Poplar Bluff.
Collins, W. M., 6131 Easton Ave., St. Louis.
Conrad, Wm., 3666 Olive St., St. Louis.
Conzelman, O., 3860 S. Broadway, St. Louis.
Cowdery, C. C., 5746 Vernon Ave., St. Louis.
Crandall, W. G., Ballinger Bldg., St. Joseph.
Cronkhite, F. P., Ballinger Bldg., St. Joseph.
Cunningham, P. T., 3133 Pine St., St. Louis.
Dameron, E. P., De Malia Bldg., St. Louis.
Darby, C. H., German-American Bank Bldg., St. Joseph.
Darby, R. E., Springfield.
Davison, C. W., Jefferson City.
Donnell, T. G., 2247 S. Grand Ave., St. Louis.
D'Oench, H. F., 2901 Lafayette Ave., St. Louis.
Draper, C. A., Windsor.
Dunham, C. S., 1400 Olive St., St. Louis.
Eisloeffel, P. H., 2353 Lafayette Ave., St. Louis.
Enloe, E. D., Cole Camp.
Enloe, H. V., Cole Camp.
Evans, J. W., 4418 N. 21st St., St. Louis.
Fendler, Max, Missouri Trust Bldg., St. Louis.
Fields, R. C., Lees Summit.
Fischer, J. A., Missouri Trust Bldg., St. Louis.
Flickinger, Adam, 1113 Pine St., St. Louis.
Franklin, F. W., Altman Bldg., Kansas City.
Frederich, V. H., 3263 S. Jefferson Ave., St. Louis.
Fries, J. A., 1540 S. Broadway, St. Louis.
Frost, C. J., Warrensburg.
Fruth, Otto, 3066 Hawthorne Boulevard, St. Louis.
Fry, J. T., Moberly.
Fulkerson, F. M., Sedalia.
Fuller, A. H., 318 N. 8th St., St. Louis.
Gardiner, W. W., Frisco Bldg., St. Louis.
Gibson, G. H., 2326 Russell Ave., St. Louis.
Good, Wesley, 409 Edmond St., St. Joseph.
Goodrich, W. G., Chillicothe.
Grissom, M. A., Cape Girardeau.
Gruebbel, A. W., Concordia.
Hadley, E. E., 1400 Olive St., St. Louis.
Hammer, Oscar, 2519 Salena St., St. Louis.
Hanley, B. S., 3680 S. Broadway, St. Louis.
Harris, S. W., Chillicothe.
Haverstick, E. E., 346 N. Boyle Ave., St. Louis.
Hempelman, W. F., New Haven.
Hollingsworth, J. G., Rialto Bldg., Kansas City.
Holton, J. R., Commercial Bldg., St. Louis.
Howard, N. U., Sedalia.
Hulen, J. A., Centralia.
Hull, J. W., Altman Bldg., Kansas City.
Hungerford, C. L., Rialto Bldg., Kansas City.
Hussey, C. B., Carthage.
Kempff, Fred, 209 N. 12th St., St. Louis.
Kennerly, J. H., 2639 Locust St., St. Louis.
Kiess, H. W., Carleton Bldg., St. Louis.
Kimbrough, H. S., 1000 N. Jefferson Ave., St. Louis.
Kimbrough, J. B., 2610 Locust St., St. Louis.
Kitchen, G. L., 3627 S. Broadway, St. Louis.
Koenig, E. L., 3305 Magnolia St., St. Louis.
LeCron, D. O. M., Missouri Trust Bldg., St. Louis.
LeCron, R. N., Missouri Trust Bldg., St. Louis.
Letord, J. S., Deardorf Bldg., Kansas City.
Lischer, B. E., Studio Bldg., St. Louis.
Loebenstein, Samuel, Altman Bldg., Kansas City.
Love, W. H., 3761 Finney Ave., St. Louis.
Lyell, T. W., Shelbina.
Lynott, F. B., Frisco Bldg., St. Louis.
McBride, C. J., Perryville.
McBride, J. B., Springfield.
McKay, C. F., Knox City.
McMillen, D. J., 11th and Locust Sts., Kansas City.
McQuinston, J. P., 5443 Easton Ave., St. Louis.
McWilliams, J. F., Mexico.
Magee, A. M., Louisiana.
Mandell, L. C., 4310 Cook Ave., St. Louis.
Manhard, O. H., Missouri Trust Bldg., St. Louis.
Mathae, G. H., 1428 Mississippi Ave., St. Louis.
Matkin, E. H., Bonne Terre.
Meriwether, C. L., Louisiana.
Miller, E. A., Hopkins.
Miller, Jesse, Maryville.
Mitchell, C. B., Bowling Green.
Mitchell, G. D., Morrisville.
Monfort, Lena S., Excelsior Springs.
Moore, M. R., Commercial Bldg., St. Louis.
Morris, J. D., 5247 Page Ave., St. Louis.
Morrison, P. H., Olivia Bldg., St. Louis.
Mosher, D. F., Bryant Bldg., Kansas City.
Moss, E. H., Chillicothe.
Mrazek, L. W., 2522 S. 12th St., St. Louis.

Musgrave, G. W., Ash Grove.
Neimeter, E. L., 1113 Pine St., St. Louis.
Nifong, S. C., 721 N. Kings Highway, St. Louis.
Owen, G. H., 3514 Lucas Ave., St. Louis.
Pasqueth, J. C., Mexico.
Patterson, J. D., Keith & Perry Bldg., Kansas City.
Peak, J. L., Lexington.
Pfaff, C. P., 1655 S. Jefferson Ave., St. Louis.
Pfaff, H. V., 2217 St. Louis Ave., St. Louis.
Pfaff, J. G., 4273 Olive St., St. Louis.
Prickett, H. D., 3906 Easton Ave., St. Louis.
Purcell, T. E., Hewson Bldg., Kansas City.
Rand, H. T., Springfield.
Ratcliff, A. B., Dearborn.
Ream, F. K., Century Bldg., St. Louis.
Reed, W. L., Mexico.
Reisse, E. C., 1505 S. Jefferson Ave., St. Louis.
Robb, Malcolm, Century Bldg., St. Louis.
Rodemich, Henry, 1634 Chouteau Ave., St. Louis.
Root, J. P., Deardorf Bldg., Kansas City.
Ross, W. F., Ballinger Bldg., St. Joseph.
Roy, J. D., Carleton Bldg., St. Louis.
Ruge, J. P., 1400 N. Grand Ave., St. Louis.
Rutledge, W. T., Monroe City.
Saner, A. W., Century Bldg., St. Louis.
Scherzinger, A., 3434 Montana St., St. Louis.
Schleef, Claire B., 2948 Washington Ave., St. Louis.
Schuck, Jacob, 939 Hickory St., St. Louis.
Seibel, R. M., Commerce Bldg., Kansas City.
Selsor, W. L., Shelbina.
Shea, Mabel E., 319 N. Grand Ave., St. Louis.
Shea, W. H., 4722 Cottage Ave., St. Louis.
Shellhorn, A. L., Kennett.
Simpson, C. O., 4237 Olive St., St. Louis.
Sone, W. J., Jefferson City.
Stamm, A. P., 1400 N. Grand Ave., St. Louis.
Staudinger, B., 3556 Lindell Ave., St. Louis.
Stemmler, L. A., 4637 Easton Ave., St. Louis.
Stevens, B. Q., Hannibal.
Stuttle, C. P., Century Bldg., St. Louis.
Sullivan, H. H., Altman Bldg., Kansas City.
Summa, C. H., Ozark Bldg., St. Louis.
Summa, Richard, Oriel Bldg., St. Louis.
Temm, W. B., 1107 N. Grand Ave., St. Louis.
Thorpe, B. L., 3666 Olive St., St. Louis.
Todd, J. A., 4109 Manchester Ave., St. Louis.
Towns, W. A., Pierce City.
Van Fossen, C. L., New Bridge Bldg., Kansas City.
Vaughan, R. R., Century Bldg., St. Louis.
Voyles, S. H., 3201 Washington Ave., St. Louis.
Wallace, J. F., Canton.
Wallace, S. E., La Belle.
Wayland, E. A., Breckenridge.
Westhoff, G. H., Olivia Bldg., St. Louis.
Weston, May, Rialto Bldg., Kansas City.
Wheat, S. C., Altman Bldg., Kansas City.
Wherritt, H. S., Joplin.
Whipple, W. L., Missouri Trust Bldg., St. Louis.
Wick, J. W., Columbia Bldg., St. Louis.
Wieser, F. J., 2004 E. Grand Ave., St. Louis.
Williams, Samuel, 4149 W. Belle Place, St. Louis.
Windhorst, M. R., 3518 Morgan St., St. Louis.
Winter, G. B., 2229 S. Broadway, St. Louis.
Wolff, A. S., 2100 N. 11th St., St. Louis.
Woolfolk, E. S., Troy.
Yeargain, G. W., 4637 Easton Ave., St. Louis.
Young, L. A., 4661 Maryland Ave., St. Louis.

MONTANA.

Battle, W. H., Great Falls.
Cutler, A. B., Kalispell.
Hampton, T. M., Helena.
Longeway, G. E., Great Falls.
Meyers, E. A., Hamilton.
Rathbone, R. R., Dillon.
Wait, D. J., Helena.

NEBRASKA.

Davidson, W. E., Holdredge.
Field, Elizabeth, 1026 O St., Lincoln.
Hunt, O. A., Bee Bldg., Omaha.
King, H. T., Fremont.
McClanahan, I. W., Friend.
Mills, Leah, 513 Paxton Blk., Omaha.
Phillips, C. A., Hastings.
Pratt, H. J., McCook.
Ross, F. R., Omaha.
Slabaugh, F. W., New York Life Bldg., Omaha.
Smith, W. R., Pawnee City.
Tefft, C. R., 1127 O St., Lincoln.
Vance, M. E., 1222 O St., Lincoln.
Wait, J. E., Superior.

NEW HAMPSHIRE.

Blaisdell, E. C., Portsmouth.
Moulton, L. I., Concord.
Sawyer, A. J., Manchester.

NEW JERSEY.

Brinkman, M. R., Hackensack.
Chace, W. G., Princeton.
Halsey, J. G., Swedesboro.
Holbrook, C. F. W., 2 Saybrook Place, Newark.
Holden, G. M., Hackettstown.
Hull, H. A., New Brunswick.
Iredell, Harvey, New Brunswick.
Irwin, Alphonso, 425 Cooper St., Camden.
Jacquette, W. A., Salem.
Luckey, B. F., 88 Broadway, Paterson.
Meeker, C. A., 29 Fulton St., Newark.
Pruden, W. H., 44 Church St., Paterson.
Sanger, R. M., East Orange.
Stockton, C. S., 7 Central Ave., Newark.
Sutphen, H. S., 24 E. Kinney St., Newark.
Truex, W. E., Freehold.
Watkins, S. C. G., Montclair.
Woolsey, Walter, Elizabeth.

NEW MEXICO.

Alger, E. J., Albuquerque.
Kraft, J. E., Albuquerque.

NEW YORK.

Armstrong, H. R., 171 W. 126th St., New York.
Bachman, C. C., Waterloo.
Ballachey, F. A., 205 Norwood Ave., Buffalo.
Beach, J. W., 680 Main St., Buffalo.
Berg, N. A., 210 Lenox Ave., New York.
Bogue, E. A., 63 West 48th St., New York.
Booth, D. N., 222 East Broadway, New York.
Breen, J. M., 125 E. 16th St., New York.
Brown, E. Parmly, 509 5th Ave., New York.
Burkhart, H. J., Batavia.
Butler, C. S., The Frontenac, Buffalo.
Carr, Wm., 35 W. 46th St., New York.
Cooke, A. R., University Blk., Syracuse.
Cowan, J. W., Geneseo.
Dailey, W. M., 30 W. 39th St., New York.
Deane, W. C., 616 Madison Ave., New York.
Dills, W. B., 260 De Kalb Ave., Brooklyn.
DuBois, C. A., 36 W. 59th St., New York.
Dunning, W. B., 50 W. 45th St., New York.
Eshelman, S., Franklin and Virginia Sts., Buffalo.
Evans, George, 55 W. 39th St., New York.
Fay, M. L., 379 Hudson St., Buffalo.
Fossume, F. L., 616 Madison Ave., New York.
Freeman, Solomon, 965 Madison Ave., New York.
Freeman, S. A., 362 Jersey St., Buffalo.
Goldsmith, S. L., 129 E. 60th St., New York.
Goode, Gladstone, 35 W. 46th St., New York.
Gough, F. A., 595 Park Place, Brooklyn.
Graves, J. W., 204 E. Main St., Rochester.
Greene, F. A., Geneva.
Griswold, E. R., Dansville.
Hammersmith, P. C., 781 Seneca St., Buffalo.
Hanley, Sara S., 2 W. 38th St., New York.
Harlan, A. W., 1122 Broadway, New York.
Hart, John I., 118 W. 55th St., New York.
Hartman, J. A., Albion.
Harvitt, Jos., 214 E. Broadway, New York.
Hawkins, F. F., Troy.
Hert, B. S., Chamber of Commerce, Rochester.
Hofheinz, R. H., Chamber of Commerce, Rochester.
Howard, F. E., 331 Franklin St., Buffalo.
Jackson, V. H., 240 Lenox Ave., New York.
Jarvie, William, 105 Clinton St., Brooklyn.
Jernigan, G. F., 61 W. 56th St., New York.
Kuntz, Emanuel, 115-17 Michigan St., Buffalo.
Leake, W. J., Lockport.
Le Roy, L. C., 6 Lexington Ave., New York.
Line, J. Edward, 39 State St., Rochester.
Link, E. G., Cutler Bldg., Rochester.
Littig, J. Bond, 61 W. 70th St., New York.
Low, F. W., 680 Main St., Buffalo.
Meisburger, L., 948 Main St., Buffalo.
Merritt, A. H., 413 Lexington Ave., New York.
Messerschmitt, Frederick, Granite Bldg., Rochester.
Muntz, Emanuel, 1157 Michigan St., Buffalo.
Nash, B. C., 142 W. 78th St., New York.
Nies, F. H., 37 Summit St., Brooklyn.
Northrop, A. L., 57 W. 49th St., New York.
Ottolengui, R., 80 W. 40th St., New York.
Palmer, Stephen, 310 Main St., Poughkeepsie.
Paull, W. W., 96 W. Chippewa St., Buffalo.
Pease, J. G., 61 W. 74th St., New York.
Perry, S. G., 46 W. 37th St., New York.
Polhamus, Agnes I., 408 Manhattan Ave., New York.
Preston, A. E., Delavan.
Pringle, G. W., Niagara Falls.
Proseus, F. W., 238 Monroe Ave., Rochester.
Pullen, H. A., Mooney-Brisbane Bldg., Buffalo.
Refsum, Jos., 123 E. 60th St., New York.

Reitz, R. B., 38 E. 61st St., New York.
Rhein, M. L., 38 E. 61st St., New York.
Schlottman, E. L., Chamber of Commerce, Rochester.
Sheckter, S. J., 1849 Madison Ave., New York.
Shields, N. T., 61 W. 56th St., New York.
Smith, W. W., 63 East Ave., Rochester.
Sookne, Jos., 202 E. Broadway, New York.
Stadlinger, Chas. H., 169 N. Pearl St., Buffalo.
Stanton, F. L., 35 W. 38th St., New York.
Starr, A. R., 8 E. 92nd St., New York.
Stillman, E. E., Watervleit.
Stuki, A. G., 505 8th Ave., New York.
Sugnet, E. L., 537 Williams St., Buffalo.
Suriani, Phillip, 141 2nd Ave., New York.
Taylor, J. W., 108 E. 57th St., New York.
Tracy, W. D., 46 W. 37th St., New York.
Wehrenberg, W. D., 210 Lenox Ave., New York.
Westbay, H. E., 219 W. 71st St., New York.
White, W. A., Phelps.
Whitmarsh, H. D., Binghamton.
Williams, F. H., Katonah.

NORTH CAROLINA.

Alexander, Charles L., 203 N. Tryon St., Charlotte.
Allen, R. T., Lumberton.
Bender, O. J., Pollocksville.
Betts, J. S., Greensboro.
Bland, C. A., Charlotte.
Brooks, J. H., Burlington.
Chambers, E. O., Asheville.
Davis, W. R., Whiteville.
Dreher, A. H., Salisbury.
Dreher, J. H., Wilmington.
Faulkner, T. H., Kinston.
Fleming, A. H., Louisburg.
Frazier, A. E., High Point.
Gorman, J. A., Asheville.
Harper, H. D., Jr., Kinston.
Houston, W. C., Concord.
Hunt, F. L., Asheville.
James, D. L., Greenville.
Jones, R. H., Winston-Salem.
McConnell, D. E., Gastonia.
Morey, A. H., Hendersonville.
Morrow, R. M., Burlington.
Ramsey, R. L., Salisbury.
Ramsey, W. B., Hickory.
Reid, J. G., Marion.
Snell, Henderson, Washington.
Tucker, E. J., Roxboro.
Turner, V. E., Raleigh.
Watkins, J. C., Winston-Salem.
Wyche, J. E., Greensboro.

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Bricker, F. A., Fargo.
Du Puis, L. V. P., Mayville.
Hallenberg, Albert, Fargo.
Johnson, A. P., Fargo.
Rawlings, G. A., Bismarck.

OHIO.

Ainsworth, H. S., Van Wert.
Ambler, H. L., 176 Euclid Ave., Cleveland.
Bale, H. N., Wellston.
Barber, L. L., 311 Summit St., Toledo.
Barnes, Henry, New England Bldg., Cleveland.
Barnes, V. E., Rose Bldg., Cleveland.
Beauman, J. B., 4th and State Sts., Columbus.
Bethel, L. P., 1255 Neil Ave., Columbus.
Birkett, C. H., East Liverpool.
Brown, H. C., 185 E. State St., Columbus.
Callahan, J. R., 25 Garfield Place, Cincinnati.
Casto, F. M., Schofield Bldg., Cleveland.
Conner, W. B., Akron.
Cottrell, H. V., 167½ S. High St., Columbus.
Custer, L. E., 28 N. Ludlow St., Dayton.
Davis, L. E., Granville.
Douglass, J. K., Sandusky.
Ebersole, W. G., Schofield Bldg., Cleveland.
Edgar, G. D., Defiance.
Edmonds, N. D., Wilmington.
Fenton, M. E., 262 Prospect St., Cleveland.
Fletcher, M. H., 11 E. 7th St., Cincinnati.
Foster, Wilson, Kenton.
Fowler, W. H., Painesville.
Frame, C. L., 60 E. Broad St., Columbus.
Grisham, J. K., 432 Clark St., Cincinnati.
Hague, W. H., Delaware.
Hale, R. F., Wilmington.
Hale, W. R., Wilmington.
Harvey, H. F., New England Bldg., Cleveland.
Hawley, C. A., The Chelsea, Columbus.
Hayden, Gillette, 112 E. Broad St., Columbus.
Heise, O. N., 16 Garfield Place, Cincinnati.
Ingram, B. P., 5 W. 8th St., Cincinnati.
Jackman, W. T., Schofield Bldg., Cleveland.
Jenkins, H. E., Ironton.

Jones, W. I., Nelsonville.
Lodge, E. B., Rose Bldg., Cleveland.
McIllroy, C. M., Delaware.
McLean, W. T., Neave Bldg., Cincinnati.
Myers, C. G., Schofield Bldg., Cleveland.
Owens, J. R., New England Bldg., Cleveland.
Palmer, Corydon, Warren.
Pettibone, J. B., Wayne Bldg., Toledo.
Phillips, H. H., 109 Garfield Place, Cincinnati.
Price, W. A., 2238 Euclid Ave., Cleveland.
Riggle, J. H., Sherodsville.
Rosenthal, C. H., Neave Bldg., Cincinnati.
Ruggles, S. D., Portsmouth.
Semans, H. M., 289 E. State St., Columbus.
Smith, C. Stanley, 142 E. 4th St., Cincinnati.
Smith, H. A., 116 Garfield Place, Cincinnati.
Smith, H. T., 116 Garfield Place, Cincinnati.
Smith, J. K., Zanesville.
Smith, W. P., 948 Central Ave., Cleveland.
Stephan, J. F., 129 Euclid Ave., Cleveland.
Stern, David, 108 Garfield Place, Cincinnati.
Strong, H. F., Rose Bldg., Cleveland.
Taylor, R. T., 337 E. 4th St., Cincinnati.
Teufert, J. F., Graysville.
Ward, C. A., Clarington.
Warren, F. L., Painesville.
Whitslar, W. H., Schofield Bldg., Cleveland.
Wilson, Geo. H., Schofield Bldg., Cleveland.
Wilson, H. R. C., Cleveland.
Young, O. M., Marion.
Zeter, W. A., 19 E. Daniel St., Cincinnati.

OKLAHOMA.

Brenneman, D. M., Hobart.
Bringhurst, T. P., Shawnee.
Colter, F. H., Oklahoma City.
Conner, W. H., Stillwater.
Furrow, M. B., Guthrie.
Grant, J. W., Oklahoma City.
Hirsch, R. O., Guthrie.
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Saunders, L. P., Pawnee.
Sparks, F. D., Ponca City.
Watkins, E. C., Jefferson City.
Wells, J. A., Shawnee.
White, C. L., Oklahoma City.
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Barber, S. J., Macleay Bldg., Portland.
Barr, C. W., Astoria.
Beatie, A. L., Oregon City.
Chance, Arthur W., Dekum Bldg., Portland.
Clark, E. G., Marquam Bldg., Portland.
Cox, N. R., Abington Bldg., Portland.
Cummings, W. A., Marquam Bldg., Portland.
Hayter, Mark, Dallas.
Hickey, Jos., Dekum Bldg., Portland.
Hurd, E. M., Salem.
Newcastle, C. C., Marquam Bldg., Portland

PENNSYLVANIA.

Andrews, R. W., 127 N. Highland Ave., Pittsburg.
Arthur, H. W., 416 Smith Blk., Pittsburg.
Ashbrook, J. S., 517 Smith Blk., Pittsburg.
Bachman, C. A., Emaus.
Bair, J. T., 34 N. 9th St., Reading.
Bassett, F. L., Girard Bldg., Philadelphia.
Beal, E. J., Sandy Lake.
Benkart, J. F., 614 Smith Blk., Pittsburg.
Bohn, H. W., 34 N. 9th St., Reading.
Booth, W. W., Carnegie.
Bordner, C. M., Shenandoah.
Bratt, C. B., 800 Arch St., Allegheny.
Brennan, J. D., Shenandoah.
Cameron, S. P., 1516 Locust St., Philadelphia.
Capon, W. A., Real Estate Trust Bldg., Philadelphia.
Cave, W. L., 115 S. 17th St., Philadelphia.
Cochran, G. W., Erie.
Cochran, Victor, 1628 N. 17th St., Philadelphia.
Crumbaker, H. E., Altoona.
Cryer, M. H., Crozer Bldg., Philadelphia.
Culver, M. B., 1529 Locust St., Philadelphia.
Darby, E. T., 1631 Walnut St., Philadelphia.
De Long, W. D., 801 Penn St., Reading.
De Puy, Hiram, 339 5th Ave., Pittsburg.
Donnegan, E. J., 110 Washington Ave., Scranton.
Elgin, A. C., 235 S. 42nd St., Philadelphia.
Endelman, Julio, 12th and Chestnut Sts., Philadelphia.
Faught, L. Ashley, 1430 Spruce St., Philadelphia.
Ficks, W. L., 6200 Penn Ave., Pittsburg.
Filbert, P. K., Pottsville.
Flint, D. W., 518 Smith Blk., Pittsburg.
Flower, J. O., 2917 Center Ave., Pittsburg.
Fordham, W. H., Connell Bldg., Scranton.
Friesell, H. E., 6200 Penn Ave., Pittsburg.
Gardiner, F. D., 1516 Locust St., Philadelphia.

Gaylord, A. N., 1831 Chestnut St., Philadelphia.
Gregg, G. T., 604 Smith Blk., Pittsburg.
Guilford, S. H., 1631 Walnut St., Philadelphia.
Habbeger, L. E., 406 Smith Blk., Pittsburg.
Hays, W. D., Greensburg.
Head, Joseph, 1500 Locust St., Philadelphia.
Hertig, O. L., Shraderman Bldg., Pittsburg.
Hertz, J. C., 111 S. 4th St., Easton.
Hitch, D. M., 3315 Baring St., Philadelphia.
Hough, G. B., Somerset.
How, W. Storer, Box 1615, Philadelphia.
Huey, Robert, 330 S. 15th St., Philadelphia.
Hutchison, R. R., 5100 Penn Ave., Pittsburg.
Jack, Louis, 1533 Locust St., Philadelphia.
Jameson, G. L. S., 1415 Walnut St., Philadelphia.
Jones, V. S., Bethlehem.
Kassab, Wadea, 802 Edgemont Ave., Chester.
Kingsley, F. J., Towanda.
Kirk, Edward C., 12th and Chestnut Sts., Philadelphia.
Klump, G. W., Williamsport.
Kratzer, C. V., 111 N. 5th St., Reading.
Kunkle, A. C., Greensburg.
Libbey, J. A., 524 Penn Ave., Pittsburg.
Lippincott, J. T., 1433 Walnut St., Philadelphia.
Litch, W. F., 1500 Locust St., Philadelphia.
Livingston, R. W., Clearfield.
Loar, B. M., Mt. Pleasant.
Luckey, S. B., 333 E. Broad St., Chester.
McAlpine, A., Bradford.
McFadden, H. B., 3505 Hamilton St., Philadelphia.
Mills, F. L., Nanticoke.
Moore, C. S., Witherspoon Bldg., Philadelphia.
Morgan, Owen, Johnstown.
Myers, H. H., 524 Penn Ave., Pittsburg.
Nones, R. H., 1710 Chestnut St., Philadelphia.
Nugent, J. C., Altoona.
Nyce, J. E., 2320 S. Broad St., Philadelphia.
Orr, A. W., West Newton.
Peeso, F. A., 3340 Walnut St., Philadelphia.
Pennington, J. A., 524 Penn Ave., Pittsburg.
Peters, C. E., Bessemer Bldg., Pittsburg.
Register, H. C., 1907 Chestnut St., Philadelphia.
Roberts, H. E., 1516 Locust St., Philadelphia.
Roe, W. J., 1210 Locust St., Philadelphia.
Sager, J. P., 3700 Hamilton St., Philadelphia.
Schamberg, M. I., 1636 Walnut St., Philadelphia.
Schlegel, G. S., 147 N. 8th St., Reading.
Scott, W. C., Lansford.
Seip, Howard S., Allentown.
Shafer, Leroy, Grove City.
Smith, D. D., 1629 Walnut St., Philadelphia.
Smith, F. M., 21 E. 4th St., Chester.
Stellwagen, T. C., 1328 Chestnut St., Philadelphia.
Swing, R. H. D., 703 N. 40th St., Philadelphia.
Thomas, J. D., 1122 Walnut St., Philadelphia.
Trueman, Wm. H., 900 Spruce St., Philadelphia.
Truman, James, 4505 Chester Ave., Philadelphia.
Turner, C. R., Dental Hall, U. of P., Philadelphia.
Warren, G. W., 1619 Walnut St., Philadelphia.
Whiteman, J. D., Mercer.
Wilson, W. C., Huntingdon.
Woodward, J. A., 1310 Spruce St., Philadelphia.
Wyckoff, W. T., Perry Bldg., Philadelphia.
Young, N. C., 215 S. Franklin St., Wilkes-Barre.

PHILIPPINE ISLANDS.

Ottofy, Louis, 50 Escolata, Manila.

RHODE ISLAND.

Gillett, H. W., 130 Turo St., Newport.
Keefe, D. F., Butler Exchange, Providence.
Kuhl, F. G., 99 Main St., Woonsocket.
Sweet, W. I., Providence.
Windsor, C. D., 86 Weybosset St., Providence.

SOUTH CAROLINA.

Albright, G. C., Laurens.
Austin, W. F., Seneca.
Boozer, J. W., Columbia.
Calvert, J. T., Spartanburg.
Carlisle, J. P., Greenville.
Colson, C. Bunting, 222 King St., Charleston.
Dotterer, L. P., 102 Broad St., Charleston.
Hair, G. F., Bamberg.
Hair, I. M., Union.

Johnston, A. P., Anderson.
Millhouse, J. W. E., Blackville.
Moore, T. T., Columbia.
Moore, T. T. Jr., Columbia.
Parker, F. L., Johnston.
Quattlebaum, E. G., Columbia.
Rogers, J. R., Dillon.
Rutledge, Brooks, Florence.
Simons, Benjamin, 93 Broad St., Charleston.
Thomson, D. P., Gaffney.

SOUTH DAKOTA.

Collins, G. W., Vermillion.
Hines, Jennie E., Lead.
McCartney, J. G., Mitchell.
Morgan, W. A., Camp Crook.
O'Neil, E. S., Canton.
Schlueter, J. A., Jr., Aberdeen.
Smoots, J. W., Beresford.
Williams, O. H., Springfield.

TENNESSEE.

Beach, J. R., Clarkesville.
Bogle, R. Boyd, 623½ Church St., Nashville.
Bogue, J. C., Harriman.
Boyd, H. T., Sweet Water.
Brabson, B. D., 522½ E. Gay St., Knoxville.
Crawford, J. Y., Jackson Bldg., Nashville.
Dale, J. A., 217½ N. Summer St., Nashville.
Gillespie, W. C., 625½ Church St., Nashville.
Gray, J. P., 212 N. Spruce St., Nashville.
Hale, T. L., Watertown.
Hines, C. E., 314 2nd St., Memphis.
Houston, J. F., Lewisburg.
Houston, P. D., Lewisburg.
Hunt, W. J., 254 2nd St., Memphis.
Johnson, H. C., Scimiter Bldg., Memphis.
Johnson, E. A., Collinsville.
Joyner, P. M., Union City.
King, W. C., 212 N. Spruce St., Nashville.
Lasater, R. L., Fayetteville.
Leonard, N. C., 625½ Church St., Nashville.
McDonald, J. P., Shelbyville.
McFerrin, Marvin, 619½ Church St., Nashville.
McGavock, R. J., Spring Hill.
Meadors, J. T., 625½ Church St., Nashville.
Melendy, A. R., Dearderick Bldg., Knoxville.
Menzies, W. P., Dyersburg.
Morgan, Henry W., 211 N. High St., Nashville.
Noel, L. G., 527½ Church St., Nashville.
Page, A. S., Columbia.
Richards, W. H., 417 W. Clinch Ave., Knoxville.
Rich, Celia, Jackson Bldg., Nashville.
Rich, S. L., Jackson Bldg., Nashville.
Ross, J. L., McMinnville.
Rowsey, J. E., Henderson.
Shotwell, F. A., Rogersville.
Sims, W. P., Jackson Bldg., Nashville.
Slack, W. M., 313 Main St., Memphis.
Slater, W. K., Empire Bldg., Knoxville.
Smith, C. H., Miller Bldg., Chattanooga.
Stewart, Howard T., Scimiter Bldg., Memphis.
Tavel, C. A., 337 Main St., Memphis.
Thompson, J. W., Humboldt.
Towner, J. D., Lyceum Bldg., Memphis.
Walker, W. G., Milan.
White, Gordon, 610½ Church St., Nashville.
Whitsitt, W. G., Lebanon.
Wiggins, F., Oliver Springs.

TEXAS.

Alexander, C. H., Mineral Wells.
Barron, S. L., Clarendon.
Barton, W. J., Paris.
Bloomstein, Harry, El Paso.
Buchanan, J. L., Bonham.
Carroll, R. W., Beaumont.
Cooke, W. H., Clarendon.
Crews, C. C., Tyler.
David, J. W., Corsicana.
Davison, H. M., Hubbard City.
Edge, C. H., Houston.
Fife, J. G., Dallas.
Gould, A. W., Taylor.
Griffis, R. D., Paris.
Harrell, H. B., Gainesville.
Hoffer, H. W., Kaufman.
Jackson, W. G., Abilene.
Jones, Bush, Dallas.
Krupp, P. C., Houston.
Lawrence, W. H., Bryan.
Markwell, R., Galveston.
Mayfield, I. T., Fort Worth.
Melton, J. T., Weatherford.
Merchant, M. S., Giddings.
Murdaugh, L. E., Celeste.
Murphy, J. M., Temple.
Owen, A., Cisco.
Rathbone, W. R., Cuero.
Robertson, L. P., Marlin.
Scherer, W. H., Houston.
Schmitt, R. L., Waxahachie.
Skeen, P. A., Texarkana.

Sonntag, A. F., Waco.
Staples, G. S., Sherman.
Staples, G. W., Dallas.
Stewart, A. J., Long View.
Traynham, R. C., Pittsburg.
Turner, Pitt S., Belton.
Walters, A. E., Denison.
Younkin, A. E., Laredo.

UTAH.

Broadbent, Wm., Eagle Bldg., Salt Lake City.
Campbell, Francis, Beaver City.
Dalrymple, W. G., Ogden City.
Davis, H. W., McCormick Bldg., Salt Lake City.
Davis, W. J., 51 Mercantile Blk., Salt Lake City.
Dunford, A. B., Walker Bros. Bank Bldg., Salt Lake City.
Ellerbeck, W. L., Hooper Bldg., Salt Lake City.
Mack, W. F., Hooper Bldg., Salt Lake City.
Rudy, L. N., Tooele.
Stiehl, G. F., McCormick Bldg., Salt Lake City.
Tripp, E. A., Hooper Bldg., Salt Lake City.
Wherry, S. W., Ogden.

VERMONT.

Blanchard, E. O., Randolph.
Chase, R. M., Bethel.
Hamilton, H. F., Newport.
Hodge, S. D., Burlington.
Jackson, J. H., Burlington.
Knight, E. W., Bellows Falls.
Lynde, F. M., Barre.
Mansen, David, Burlington.
Mound, Thomas, Rutland.
Wright, W. H., Brandon.

VIRGINIA.

Campbell, H. W., Suffolk.
Detwiler, B. B., Herndon.
Eggleston, Edward, 1 N 6th St., Richmond.
Ferguson, D. A., 609 N. 2nd St., Richmond.
Moore, J. Hall, 104 N. 9th St., Richmond.
Newland, C. A., Wytheville.
Norris, W. E., Charlottesville.
Pearson, W. H., Hampton.
Pilcher, Wm., Petersburg.
Simpson, R. L., Fincastle.
Stiff, F. W., 600 E. Grace St., Richmond.
Taylor, G. G., Chase City.
Womack, C. T., Martinsville.

WASHINGTON.

Hergert, E. W., 28 Coleman Blk., Seattle.
Stryker, G. W., Everett.

WEST VIRGINIA.

Black, F. L., Bluefield.
Brashear, K. C., Wellsburg.
Dowden, J. E., Fairmont.
Epling, G. T., Keystone.
Hill, E. B., Marlinton.
Kelly, W. H., Wheeling.
Lindsay, L. H., Buchanan.
Sutphin, S. S., Beckley.

WISCONSIN.

Albrecht, E. J., Mayville.
Babcock, C. L., Colby Bldg., Milwaukee.
Banzhaf, H. L., Wells Bldg., Milwaukee.
Brennan, F. D., Ashland.
Brown, G. V. I., 445 Milwaukee St., Milwaukee.
Chittenden, C. C., Madison.
Colleran, Wm., La Crosse.
Cudworth, W. H., 128 Wisconsin St., Milwaukee.
Fee, A. G., Superior.
French, E. C., Eau Claire.
Gatterdam, E. A., La Crosse.
Gropper, Adolph, Goldsmith Bldg., Milwaukee.
Halferty, F. W., Lancaster.
Hauser, G. T., La Crosse.
Levings, A. H., Wells Bldg., Milwaukee.
Maercklein, B. G., 307 Grand Ave., Milwaukee.
Malone, J. L., Superior.
Marlow, S. A., Bloomington.
Meyer, L. A., Oconomowoc.
Oliver, W. G., Oconto.
Page, M. J., La Crosse.
Reed, J. J., Beloit.
Richter, R. G., 128 Wisconsin St., Milwaukee.
Seeger, C. H., Manitowoc.
Van Stratum, F. G., Hurley.
Watrous, A. S., Kewaunee.
Wright, J. J., Wells Bldg., Milwaukee.

WYOMING.

McCrillis, M. S., Douglas.
Stahl, F. M., Sheridan.

Uruguay.

Burnett, John S., Montevideo.
Cassullo, Francisco, Andes 206, Montevideo.

Fourth International Dental Congreſs.

GENERAL SESSIONS.

GENERAL SESSIONS.

OPENING SESSION—Monday, August 29, 1904.

The first general session was called to order at 11 A.M. Monday, August 29th, by Hon. Howard J. Rogers, director of congresses of the Universal Exposition.

Rev. H. H. Gregg, St. Louis, invoked divine blessings on the deliberations of the congress.

ADDRESS OF WELCOME ON BEHALF OF THE UNIVERSAL EXPOSITION.

Hon. Howard J. Rogers, in opening the congress, and welcoming the members on behalf of the Universal Exposition, spoke as follows:

Members of the Fourth International Dental Congress, ladies and gentlemen: It gives me great pleasure on the part of the Universal Exposition to welcome you to this city today. To the members of the International Dental Federation; to the members of the National Dental Association; to the foreign delegates who are accredited by their respective governments; to the members of the profession, whether in this country or abroad, the Exposition extends a most cordial welcome! We are glad to have you with us!

The profession of dentistry has made enormous strides during the past ten years, and our states are engaged at the present time in passing laws which shall govern the entrance to the study of this profession, and improve the college curriculum and govern the entrance to the profession itself. We expect, therefore, that from your sessions this week much of profit will accrue to this and other countries on matters connected with your profession, and we expect from a legislative standpoint to receive valuable advice in framing proper laws for the development of dentistry. We hope, however, from an Exposition standpoint, that you will find time during your deliberations to visit us at the great Exposition in the western part of the city, which should appeal to you sympathetically because it has been promoted upon educational lines. Our appeal to the government for funds, to foreign governments for co-operation, to the states of the Union for support, has been based upon this plea of education—of course meant in its broadest sense: the education which comes from observing arts and architecture in heroic form;

from exhibits as here grouped together with due regard to their interrelation and interdependence, wherein the raw material is taken and under our eyes transposed into the finished article ready for the markets of the world. These exhibits have all been prepared with great expense and care, and we hope that you will avail yourselves of the opportunities there presented. If you are seeking for mental development this week, you will find it, I am sure, in the fifteen large buildings, crowded with the best things from all parts of the world, and from the many state and individual exhibits surrounding them. If you are in search of physical development, you will find it, I am sure, while roaming over the twelve hundred acres comprised in the Exposition grounds. If you are seeking for relaxation and rest, we have to commend you to that paradise of amusement, the pike. All this we extend to you.

A very material part of the development of this Exposition has been a series of congresses and conventions. We have had something like two hundred conventions held under the Exposition auspices. To these we have given every opportunity and attention to make it a satisfactory meeting-place. We have scheduled twenty international congresses connected with the different sciences and professions, and these will culminate in the latter part of next month in the great Congress of Arts and Science which can be designated as a symposium of the scientific work of the world.

The Fourth International Dental Congress is the third in number of this great series of international congresses. In the organization of these various congresses it has been our policy to work through the national association of this country allied with that specialty, believing that it was best to do so because it would bring the people interested in that science or in that profession closely in touch with its development, and furthermore because we believe that the best interests of the Exposition and of the profession concerned could be promoted simultaneously. For that reason we have worked in your own case through the National Dental Association, and made the committee appointed by that association our Committee of Organization. We have given them every support, believing that they represented the best element of the profession in all parts of the country or else they would not have been certified to us by the National Association.

No one who has not had experience in the development and promotion of a great international congress can have any idea of the amount of work, the amount of time, and the amount of sacrifice necessary to bring it to a consummation. I venture to say that if every member of the Committee of Organization could have known two years ago what they know today of what was required of them in work, money, and effort, hardly one would have been willing to undertake it. It means a great deal of hard work and much criticism. Every committee of organization, however, must have two things fixed before them in order to bring about a successful congress. They must have a program which in strength and timeliness of subjects should be of special interest to the profession. It must also bring together an audience capable of appreciating that program. These two objects must be sought, and I would be remiss in my duty and profligate of my opportunities if I did not take this occasion on the part of the Exposition to render thanks to the Committee of Organization for the magnificent work they have done since they were appointed. To the chairman, who has looked particularly after the funds and the many and varied details of organization, all of which have been conducted with consummate executive ability; to the secretary, who has conducted a correspondence running into reams and reams of paper; to every member of the Committee of Organization, who has done well and to the best of his ability the particular duty assigned to him—again on the part of the Exposition I express our appreciation of their work.

We come now, gentlemen, to the permanent organization of the Fourth International Dental Congress. Following the procedure which has obtained in all of the other international congresses held under our auspices, we some time ago instructed the Committee of Organization to make a permanent roster of officers to preside over this convention, believing that by so doing we were contributing to the stability of the congress, to the contentment of individuals, and to the permanence of the program, and that we were working for the best interests of the congress. We have found, however, that there is a strong opinion among the members of this convention—whose opinion we most highly respect—that the report of the nominating committee of the Committee of Organization should be submitted to your honorable body for ratification — (applause) — and at the special request of the chairman of the Committee of Organization, Dr. Burkhart, and at the request, passed in due form, of the committee, we will now rescind that former order, and present to this convention the nominations individually, so that there may be a convincing expression of opinion as to the gentlemen who shall preside over you during the congress.

The question therefore is, What action shall be taken upon the original report of the nominating committee, certified to us in due form by the Committee of Organization, nominating Dr. H. J. Burkhart for president of the Fourth International Dental Congress?

Dr. B. HOLLY SMITH, Baltimore, Md. Mr. Director, it is more than pleasant for those who have been interested in the organization of this congress to have your public commendation of the work of the organization committee.

Townsend, in a little book entitled "The Art of Speech," quotes from an unknown writer the following: "The apple of discord has been thrown into our midst, and unless it be nipped in the bud it will burst into a conflagration that will deluge the world." Mr. Director, I cite this quotation because it is my personal desire that you should not regard these evidences of contention as a serious matter. It may be that some frugal member of this convention may have an apple or two in his pocket, but it is not the kind with which to start a fire, nor, if there should be some little heat, is there any probability of that deluging the world or interfering with the work of this congress. I have personally known some of the members of this committee for a number of years, the chairman especially, before he became a practitioner of dentistry. I have known him to be an honorable, upright, conscientious, energetic man in all of his professional work, and I feel that this congress will do itself credit, and do the graceful thing in honoring him who has borne the brunt of the work of organizing this congress; and I therefore move you, Mr. Director, that the action of the nominating committee in nominating him for the presidency of this congress be confirmed, and that Dr. H. J. Burkhart be elected president. (Applause.)

Dr. R. H. Hofheinz, Rochester, N. Y. Mr. Director, as a member of the Committee of Organization, of which you have spoken so flatteringly and appreciatively, I take great pleasure in seconding the motion of Dr. Smith that the action of the nominating committee be confirmed, and that Dr. Burkhart be elected the president of the Fourth International Dental Congress.

Mr. Rogers. The question before the house is, Shall the action of the nominating committee for the presidency of this congress, as recommended by the Committee of Organization, be ratified?

The motion was carried, and Mr. Rogers declared the action of the nominating committee in nominating Dr. Burkhart for president ratified and adopted.

Dr. C. N. Johnson, Chicago. Mr. Director, I should like to move that this election be made unanimous.

Mr. Rogers put the motion, and the election of Dr. Burkhart for president was made unanimous.

Dr. Burkhart was escorted to the platform, and Mr. Rogers introduced him as follows: "Gentlemen of the convention, I have the honor to introduce to you your presiding officer, Dr. H. J. Burkhart." (Applause.)

Dr. Burkhart. Gentlemen of the Fourth International Dental Congress, I thank you deeply for this expression of confidence, and for confirming the action of the nominating committee and the work which that committee has tried to do conscientiously and for the best interests of this congress.

The next order of business will be the election of the secretary-general.

Dr. James Truman, Philadelphia, Pa. Mr. President, I wish to nominate for the office of secretary-general Dr. Edward C. Kirk of Philadelphia. (Applause.) I take great pleasure in saying that Dr. Kirk has from the very inception of this movement done a large portion of the work connected with it. By day and by night that gentleman has worked faithfully up to the present moment, and he resigned from the secretary's work simply because he found that the committee had decided to elect the officers of the congress permanently, and because of the fact that his word, which had been sent broadcast over the world, was pledged to the principle that the congress would elect its own officers. He had said that the congress would and should elect its own officers, and therefore he would not allow his name to be used when the time for electing officers by the Committee of Organization came. Now, the question before you is whether you will elect this man, who has done so much for this congress, or someone else. I have no objection to that someone else, but I do object to allowing an individual who has accomplished so much to be overlooked by the congress. Generally speaking, I do not care personally who the officers of this congress are; that is not my object—my desire is for the advancement of the dental profession scientifically; but I want you to understand that when a man has done all that Dr. Kirk has done for this congress, it is our right and our duty to elect him, and I therefore nominate him for secretary-general of the Fourth International Dental Congress. (Applause.)

Dr. E. T. Darby, Philadelphia, Pa. Mr. President, it gives me great pleasure to second the nomination which has been made for Dr. Kirk as the secretary-general of the Fourth International Dental Congress. (Applause.)

Dr. G. V. I. Brown, Milwaukee, Wis. Mr. President, the motion is out of order. The method of procedure begun by Mr. Rogers was that each of these nominations be submitted to the congress for ratification or non-ratification of the action of the Committee of Organization.

Dr. Wm. Conrad, St. Louis, Mo. As a member of the committee which nominated the officers for the Fourth International Dental Congress I would state that we nominated Dr. Burkhart for president; Dr. Kirk for secretary-general, and Dr. Finley for treasurer. Dr. Kirk resigned his position after being elected, and Dr. A. W. Harlan was elected to take his place. I move, Mr. President, that this congress indorse the action of the nominating committee in nominating Dr. A. W. Harlan for secretary-general.

The motion was seconded by Dr. J. Y. Crawford, Nashville, Tenn.

Dr. Conrad's motion was lost.

Dr. Truman. Mr. President, I now renew my nomination of Dr. E. C. Kirk for secretary-general of the congress.

Dr. Wm. Conrad, St. Louis. I nominate Dr. A. W. Harlan for secretary-general of the congress.

A rising vote was taken on the two nominees, and resulted in the election of Dr. Kirk.

Dr. Kirk was escorted to the stage, and was presented to the audience by the president.

Dr. E. C. Kirk. My friends, I have neither the strength nor nervous energy to at this moment say more than that I thank you from the bottom of my heart for two things: First, for all that this means of personal regard and confidence; and second, that it represents, I believe, the allegiance to the principle which has been so gracefully conceded by the Committee of Organization, namely, the right of every man to express his views upon this question. (Applause.)

The President. The next order of business is the ratification of the action of the nominating committee in nominating Dr. M. F. Finley for treasurer of the Congress.

Dr. Wm. Conrad, St. Louis, Mo. Mr. President, I move that the nomination of Dr. Finley for treasurer be ratified by this body.

The motion was put before the house, and Dr. Finley was duly elected treasurer of the Fourth International Dental Congress.

Dr. Finley was escorted to the platform and introduced by the president as follows: Gentlemen of the Fourth International Dental Congress, I have great pleasure in presenting to you the gentleman who presides over the funds of this congress. (Applause.)

Dr. Finley. Mr. President and gentlemen, I would like to be able to thank you as gracefully as has Dr. Kirk, and if you will accept his words for mine, I will thank you.

The President next introduced Dr. C. S. Butler, Buffalo, N. Y., chairman of the Finance Committee, who thanked the members for their hearty co-operation in carrying out the work of his committee.

The President then invited all of the honorary presidents and vice-presidents in the audience to come upon the platform.

The PRESIDENT. Gentlemen and ladies of the convention, I have pleasure in presenting to you my long-time friend and colleague, Dr C. N. Johnson of Chicago.

Dr. JOHNSON. Mr. President and gentlemen of the congress: This is entirely a surprise to me, but I do want to thank most heartily your presiding officer for giving me the pleasure of looking you in the face, and begging you to go to work from this time forward with the one object of making this the best meeting ever held in the history of dentistry. If perchance there has been any feeling developed, let us crush it out and as one man let us all work together to do the best we can for the profession of dentistry.

The PRESIDENT. The Governor of Missouri was invited to make an address of welcome on this occasion, but was unable to be here, and in his absence you will listen to a letter from him, which will be read by the secretary-general.

Dr. KIRK, the secretary-general, then read the following communication from Governor Dockery:

ST. LOUIS, MO., Aug. 28, 1904.

To DR. B. L. THORPE.

My dear Sir,—I profoundly regret my inability to be present tomorrow and welcome the delegates to the Fourth International Dental Congress. It would have been a real pleasure for me in behalf of the people of Missouri, to have extended a cordial greeting to this large body of representative and intelligent citizens. Please present to the congress my regrets that official duties prevent my attendance, and also convey my best wishes for a pleasant and instructive occasion.

Your friend,
A. M. DOCKERY.

The PRESIDENT. Ladies and gentlemen, I have the honor of presenting to you the honored president of the National Dental Association, Dr. C. C. Chittenden of Madison, Wis., who will now address you.

Dr. CHITTENDEN. Mr. President, ladies and gentlemen: Great undertakings can only be brought to a successful issue by a careful, well-planned course of procedure and development, controlled by an intelligent comprehension of the objects sought to be attained. Time, patience, and unswerving courage and fidelity—regardless of all personal sacrifice—must be freely thrown into the balance by those who undertake to create and set in motion the machinery required to successfully bring together representative men from all the civilized nations of the earth for the uplifting of a common cause.

Two years ago the National Dental Association, which body I have the honor to officially represent today, received an invitation from the officials of the Louisiana Purchase Exposition to create and put in operation an International Dental Congress, to be held in St. Louis. That invitation was accepted, and a commission of fifteen was appointed to the arduous undertaking. The work was taken up by that commission, and despite the thousand difficulties and obstacles that beset the way—some of them apparently impregnable as Gibraltar itself—the result of its labors stands before us today in the form of a noble, completed, symmetrical achievement—the Fourth International Dental Congress.

Too much cannot be said in appreciation of the untiring labor and self-sacrifice through which this result has been brought about. On behalf of the National Dental Association I here publicly thank the committee of fifteen collectively and individually for their faithful performance of the duties set them.

This congress, whose opening we are met to celebrate, could not have been made possible but for the never-failing guidance, counsel, and (when needed) authoritative direction of a master mind in the person of the director of congresses, Mr. Howard J. Rogers, to whom each one of us here owes a deep debt of gratitude.

The deep interest created in this enterprise throughout the countries of the world is clearly evidenced by the presence here today of eminent, illustrious representatives and large delegations of dentists from practically every civilized nation of the earth. On behalf of the National Dental Association I extend to these professional brothers gathered under this roof from the very ends of the earth, seeking the development of scientific light and knowledge in their chosen calling,—to all these I extend the handclasp of greeting and warmest words of welcome.

Under the skilled business management of the Finance Committee there is every reason to expect that this congress will present a happy contrast, as to its final solvency, to most such undertakings. An ample equipment for each of the sections has been assured.

Finally, to all who have in any way contributed to the success of this great enterprise I here offer the sincere thanks of the National Dental Association. (Applause.)

The PRESIDENT. The address of welcome on behalf of the dental profession of the state of Missouri will be delivered by the gentleman to whom, I believe, belongs the credit of discovering this congress. I take great pleasure in introducing to you Dr. Burton Lee Thorpe of St. Louis, Mo. (Applause.)

ADDRESS OF WELCOME ON BEHALF OF THE DENTAL PROFESSION OF MISSOURI.

Mr. President, and Members of the Fourth International Dental Congress: Proud to be an American citizen, prouder still to be an American dentist, and to have aided in a humble way to make it possible for this great meeting to be held, this is the happiest opportunity of my professional career—to be delegated the very delightful duty of bidding you a most cordial and sincere welcome on behalf of the profession of the state of Missouri and the city of St. Louis.

Recognizing that each of you, delegates coming from foreign countries and the states, territories, and provinces of North America, represents the best interests of the profession of your various localities, and that each of you has contributed either to the science, art, or literature of dentistry, I am frank to confess that the profession of Missouri feels highly honored to greet and welcome such a distinguished body of representative men and women of the dental profession.

It is fitting, indeed, that during the great Universal Exposition now in progress at the western portals of our city, that is held in commemoration of that historic event when Napoleon Bonaparte, with a stroke of the pen, signed away and gave to Thomas Jefferson and the American people an empire of which imperial Missouri is the most important state—it is fitting, I say, at this time that there be held, as one of a series of many important educational and scientific congresses, the Fourth International Dental Congress.

It is the spirit of the Exposition to show the achievements of human progress, so aptly illustrated by Mr. Chang Yu Tong, the talented interpreter of

China of this congress, in the following sentiment:

Well blessed with man's success, Columbia fêtes
In festal hall the nations and her states;
From every clime her honored guests have come,
From far Cathay and Europe's Christendom,
From silver-mantled regions of the poles,
From golden shores where sparkling river rolls;
Her states, like jewels in a coronet,
Around the hall her loving hands have set.

The wine of friendship bubbles in the glass,
From hand to hand the fragrant roses pass;
The song of thanks is swelled by every tongue,
The nation's hymn is sung by old and young.
Rejoice, Columbia! Lead the gallant van,
And show the world the worth of man as man:
Be thou the champion of the human race,
And break the chains which manhood may disgrace;
The nations, young and old, to thee resign
The sacred scepter and a task divine.

It is also the spirit of this congress to welcome our professional *confrères* from every civilized country, and to unite with them in comparing the wonderful strides the humane and beneficent profession of dentistry has made by enmassing the investigators, teachers, journalists, and active progressive practitioners of dental surgery, the recognized leaders in art, science, and technique, to demonstrate both clinically and theoretically the latest and best in odontological science.

We are gratified that in the master minds of two American dental pioneers originated the three most potent factors in dental education—the organization of the first dental college, the first dental journal, and the first dental society that brought our calling out of chaos, and made it blossom from a trade into a profession. We know that yesterday's achievements are not forgotten in the onward movement of today, when all nations in reverential homage do honor to the memory of the progenitors of dental science—Horace H. Hayden and Chapin A. Harris.

We are not unmindful, however, of the achievements of the staunch pioneers of Europe, to whom we also must give ample credit for their contributions to our profession.

One hundred years ago, when St. Louis was a frontier trading-post on the banks of yonder river, records say that the first regular dental practitioner was Dr. Paul, a Frenchman of New Orleans, who located here in 1809, soon to be followed by other pioneers, such as Isaiah Forbes, B. B. Brown, Edward Hale, Sr., A. M. Leslie, Isaac Comstock, Aaron Blake, J. S. Clark, H. E. Peebles, C. W. Spaulding, Henry Barron, Homer Judd, C. W. Rivers, Henry S. Chase, Wm. H. Eames, Edgar Park, Wm. N. Morrison, and lastly our distinguished Henry J. McKellops, whose names will ever illumine the pages of Missouri dental history.

This coterie of men stood for progress, and were foremost in city, state, and national dental affairs, and I thank God that the better element of their successors are also imbued with the same progressive spirit, which is proved by their loyalty and liberality in making this congress a success. On behalf of these self-sacrificing, broad-minded, liberal-spirited dentists of St. Louis and Missouri, I welcome you!

We welcome all nations. We welcome you of Spain, whose generous Queen Isabella long ago equipped the fleet that brought Columbus on his voyage of discovery to our shores. Our hearts also go out to you for the courteous and chivalrous treatment tendered our sailors while the captives of your gallant Admiral Cervera at Santiago.

To you, sons of England, the mother of

America: We bid you welcome! Once we were your unruly child; you tried to chastise us, but we had outgrown our swaddling-clothes—you failed; but now the British lion and the American eagle are bosom companions. We heartily appreciate the recognition England has granted that distinguished scientist, our fellow countryman, J. Leon Williams.

To Sweden, who gave us Ericsson, and to Norway, who gave us so many of your sturdy sons and fair daughters who have by their industry made parts of America blossom as a garden: We bid you welcome!

To France, who in the dark days of the American revolution sent us the gallant Marquis de Lafayette and Count Rochambeau and their thousands of fellow patriots who did so much to aid us to gain our independence, we are especially indebted. With these generals of army and navy came two men who have left their imprint indelibly stamped on American dentistry—Joseph Françoise Lemaire and James Gardette, distinguished as skilled operators, contributors to dental literature, and the pioneers in introducing dental surgery in America: We welcome you!

To Germany, whose countrymen have done so much in developing America and have made such excellent citizens: We bid you welcome! and we thank you for the fraternal recognition you have given those two distinguished American practitioners who are the foremost in the world in their specialties—W. D. Miller and N. S. Jenkins.

Lord Bacon says, "Every man owes a debt to his profession," and we feel that you who speak in different tongues, who have crossed the seas to attend this congress, have at least in part liquidated your indebtedness to the profession.

To all nations: to all members of the Fourth International Dental Congress: We bow our heads in salute to you; we bid you welcome from the bottom of our hearts! Our homes are open to you, our hands are at your service. We recognize the fact that you represent the intellect and flower of dentistry of the world, and the profession of Missouri and of St. Louis are flattered to have you here. It is our hope that you may reap untold benefit from this historic meeting, and when you return to your respective homes, may you carry pleasant memories of our people, state, and city; and when your life's work is ended, may you each realize the reward that Kipling so beautifully pictures as the heaven of the honest workingman as symbolized by the painter:

When earth's last picture is painted and the
    tubes are twisted and dried,
When the brightest colors have faded, and the
    youngest critic has died,
We shall rest, and faith! we shall need it—
    lie down for an æon or two,
Till the Master of all good workmen shall
    put us to work anew.
And those who were good shall be happy:
    They shall sit in a golden chair;
They shall splash at ten-league canvas with
    brushes of comet's hair;
They shall find real saints to draw from—
    Magdalene, Peter, and Paul;
They shall work for an age at a sitting, and
    never be tired at all!
And only the Master shall praise us, and only
    the Master shall blame;
And no one shall work for money, and no one
    shall work for fame;
But each for the joy of working, and each
    in his separate star
Shall draw the Thing-as-he-sees-it, for the
    God of Things-as-they-are!

The PRESIDENT. I now have pleasure in presenting to you the vice-president for America of the International Dental Federation, who will welcome the foreign delegates to the Fourth International Dental Congress.

Dr. A. W. Harlan of New York then delivered the following address:

ADDRESS OF WELCOME TO THE FOREIGN DELEGATES.

Mr. President, ladies and gentlemen, and Members of the Congress from foreign countries: I am indeed fortunate to be able this day to greet you as the official mouthpiece of the Committee of Organization of this congress. It looked for a long time as though the Fédération Dentaire Internationale and the committee could not come together, but today all differences are settled, and we appear before you as a united profession.

The World's Dental Congresses have become fixed institutions in the same way that other congresses have been evolved. The profession needed congresses. The world would be benefited in consequence of their evolution, and we have them. They are a part of our armament, just as physiology and chemistry are a part of the education of the dentist.

The members of our profession in the United States having chosen me to extend to everyone present from a foreign shore the right hand of fellowship, I give you a cordial fraternal welcome in this noble hall and in the presence of this multitude of our own people.

This is the second time in the history of our profession that an international dental congress has been convened in the United States—1893 and 1904. The origin of dental congresses, as you well know, was in the land of Ambroise Paré, Roux, Fauchard, Jourdain, Lefoulon, Robin, Magitot, Paul Dubois, Lecaudey, and Godon. It is our hope and wish that everyone here this day will feel that he is thrice welcome to participate in the program of the week, and that all will feel that time and distance will count as nothing when they sum up the benefits derived from what they see and hear.

On behalf of the officers and the management of the congress, and the united dental profession, I again bid you all a hearty welcome.

Dr. A. W. Harlan, New York, called upon by the President to introduce the foreign delegates to the congress, made a few appropriate remarks in presenting Dr. Otto Zsigmondy, Vienna, the official representative of Austria, who spoke as follows:

Mr. President, ladies and gentlemen: I thank you from the bottom of my heart for this very kind and enthusiastic reception. In Austria, as in other countries, a remarkable change has taken place, in the sense that dentistry is now fully recognized by the government as being of the utmost importance to public hygiene. As a proof of the increasing interest our authorities are taking in dental matters, I should state that, not content to gather information about international dental congresses from the official reports, they deemed it fit to appoint an official delegate to this congress. The desire often expressed by the Austrian dental societies may now be considered almost realized.

I wish to be permitted to mention another improvement which is likewise the result of our efforts. Special dental courses have been organized for army surgeons in which they can obtain not only the special training desirable, but at the same time they attend gratuitously to the teeth of the soldiers of the Vienna garrison.

To these statements I have only to add my sincerest thanks for the privilege of having been permitted to address to you these words, and to express a confident hope that the results of this great and memorable congress will bear further good fruit for my country also. (Applause.)

Dr. **Rudolph Weiser** of Vienna, Austria, delegate from the Central Union of Austrian Stomatologists and the Association of Dentists of Prague, was next introduced, and spoke as follows:

Mr. President, ladies and gentlemen: If the wonderland America is in general a voyage-aim for the cultivated classes of society, a dental congress in the United States will exert upon us as professionals an attractive power to a most exceptional extent.

The Americans have always been ahead in converting theoretical results into practical applications of benefit to mankind. Consequently, and by natural logic, they ought to distinguish themselves in dentistry, and indeed they may be considered pioneers in this branch of knowledge.

I should now like to inform you that we Austrians have a still greater incentive to study your institutions thoroughly and to enter into friendly personal contact with you because the universities in our country are just about to place education in this branch of surgery upon a new and sound basis.

I have the honor to express to you, in the name of the Central Union of Austrian Stomatologists and of the Association of Czech Dentists of Prague, the most cordial thanks for your kind invitation and warm reception. As the delegate of the aforenamed dental associations I feel happy to transmit you the sincerest wish that the results of your enterprise may be of real benefit to the nations of the world. (Applause.)

Dr. Harlan next introduced Dr. **Alfred Burne**, the representative of Australia, who spoke as follows:

Mr. President, ladies and gentlemen: I trust I shall be pardoned this morning if I take for my cue a line from the ghost in Hamlet, "Brief let me be." I feel that there are so many to follow me that I do not desire to take your time. From the state of Victoria, New South Wales, I desire to extend to the congress congratulations and good wishes for a very successful meeting. I feel that we who have come such long distances to this congress are like the wise men who followed the star of Bethlehem. We are looking to the Fourth International Dental Congress, seeking the light that we need, and which I think we shall find. Gentlemen, I thank you. (Applause.)

Dr. **J. M. Magee**, St. Johns, N. B., Canada, was next introduced and spoke as follows:

Mr. President, ladies and gentlemen: I came here simply as a dentist, and it was with the greatest distress that I learned I would be called upon to speak for the great country to the north. Canada is a great big country, with a lot of good material that requires polishing, and I may say that when we want polishing we know where to go for it. Some of our good material when it comes here, however, is gathered in by the United States, for the United States knows a good thing when it sees it, and has taken possession of many of our most worthy representatives, prominent among whom is our honored Dr. C. N. Johnson. (Applause.)

I am very sorry that I cannot respond on behalf of the profession in Canada as befits the occasion, but the representative who could worthily represent it is unfortunately absent, and I was unexpectedly called upon to take his place. I am very proud to be honored on this occasion by being permitted to speak to you, and, as my predecessor from the antipodes expressed it, I thank you. (Applause.)

Dr. E. SAUVEZ, Paris, was next introduced, and addressed the meeting as follows:

Mr. President, ladies and gentlemen: In the name of the government of the French Republic, of which I have been commissioned delegate together with my eminent *confrère* and friend Dr. Godon, I have the honor of saluting the aurora of the Fourth International Dental Congress.

I will also present you the good wishes for the success of this meeting on behalf of the Directeur de l'Assistance Publique of Paris, who has delegated us for the purpose; and finally, as president of the French committee on publicity and propaganda and of the national federation of France, I want to offer you the assurances of our sentiments of confraternity and sincere admiration for the constant efforts which American dentists have been making for so many years for the purpose of elevating the status of our profession.

The École Dentaire, Paris, which represents the most important institution for dental education and the most vital one in our country, takes the greatest interest in your work, in your journals, in your schools, because you have traveled toward the ideal with gigantic strides. Sixty-five years ago the first dental school in the world was created in Baltimore. Today about sixty-five schools are being operated upon United States territory. It must be clear to everyone that a country capable of creating on an average a school per year must necessarily be that in which the status of the profession is the highest.

We are particularly happy to bring to you our token of admiration in this beautiful city of St. Louis, the heart of the United States, where so many names remind us of France, the first one to give to the modern centuries, through the cession of Louisiana, the example of a colony voluntarily ceded by the parent country, and when we look at the prosperity of your beautiful country, and at the splendor and importance of your Exposition, we cannot refrain from thinking of the just statements made by Livingston, the ambassador of the United States, at the time of the signing of the Louisiana Purchase. He prophesied the future in such a precise way that you have not hesitated to inscribe part of it upon the monument commemorating the event.

Dr. W. D. MILLER, Berlin, the representative from Germany, was greeted with loud applause.

Dr. HARLAN. It is not necessary, it seems, that I should introduce Professor Miller, our distinguished representative from Germany and the guardian of American dentistry in Europe.

Dr. MILLER. *Mr. President, ladies and gentlemen:* I do not need to say that I thank you very heartily for this courteous show of friendship on your part, and that I reciprocate it most fully. I come to you as the representative of the National Dental Association of Germany, of the National Association of Dental Societies, and of the National Association of Dental Faculties of Germany. These three bodies embrace, I may say, practically all the prominent dentists of the country, and they have asked me to convey to you an expression of cordial goodwill and sympathy. They wish me to assure you also of their great appreciation of the grand work done in America by the dental profession, and of their hope and confidence that this meeting will, like all other dental meetings held on American soil, contribute much to the advancement of our profession. (Applause.)

Dr. HARLAN. I have pleasure in introducing to you the representative of the government of Holland, Dr. John E. Grevers, Amsterdam, who was a member of the International Medical Congress held in Washington in 1887, and of the World's Columbian Dental Congress of 1893 in Chicago.

Dr. JOHN E. GREVERS. *Mr. President, ladies and gentlemen:* I thank you very heartily for your kind reception, and I thank you for the opportunity you have given me of coming before you as the representative of a very small country—a country, however, which is full of loving interest for everything pertaining to dentistry. My gracious little queen, Wilhelmina, has kindly delegated me to represent her government at this congress; and this act marks the beginning of a great period for Holland, as the government is becoming more and more interested in matters relating to dentistry, which in our country has for many years been regulated by law, but not to its best interests, I am sorry to say. I think I can now prophesy that the present ministry will do much toward bettering the conditions for the study of our specialty.

I have also come to bring you greetings from two dental societies, the Odontological Society of Holland and the Union Society of Dentists. Both have delegated me to represent them, and to bring to you their heartfelt greetings, and the hope that the outcome of this congress will be most beneficial to dental science throughout the world. Again I thank you for your very kind reception. (Applause.)

Dr. VINCENZO GUERINI, Naples, the representative of Italy, was introduced by Dr. Harlan, and spoke as follows:

Mr. President, ladies and gentlemen: As the representative of the Odontological Society of Italy and of the Neapolitan Medical Association, I have the honor of bringing to you a fraternal greeting from the Italian dentists.

A strong current of sympathy, originating from great historical events that are known to all of us, unites and will ever unite Italy to America. Every new manifestation of progress, every fresh success of yours, has our sincere applause, and my colleagues in Italy hope that this great dental congress may add a new glory to the many accomplishments which your nation can already boast.

It is the source of great happiness to me to find myself for the first time in the United States, in this great center from which the light of civilization and of progress radiates so abundantly over the whole world; and this day, when I have the honor of standing in the midst of so eminent an assemblage of talent, constituted for the most part of the elect of the dental profession in America, will ever be one of my dearest remembrances.

In conclusion, gentlemen and ladies, I will express my fervent desire that the brilliant results of this great international congress may constitute a new and solemn affirmation of the autonomy of dental science, which Americans have the merit of being the first to recognize, and which is the indispensable condition of rapid progress in dentistry.

May this congress strengthen still more the bond that unites all the dentists of the world into one body, rendering it more easy for the dental profession to achieve fresh triumphs in the field of scientific and practical dentistry for the welfare of humanity. (Applause.)

Dr. José J. Rojo, Mexico City, Mexico. *Mr. President, ladies and gentlemen:* I thank you for your kind reception. It is with great pleasure that I have the honor of addressing you as delegate from the National Mexican Dental College and from the Mexican Dental Society. Permit me to express our feelings of appreciation and special sympathy with the organizers of and co-operators in this great historical event, the Fourth International Dental Congress. Besides this, in the name of the dental profession of the Republic of Mexico, I want to express our best wishes for a successful meeting, and many beneficent results to our profession. (Applause.)

Dr. Jaime D. Losada, Madrid, one of the representatives from Spain, spoke as follows:

Mr. President, ladies and gentlemen: I feel a deep sense of emotion on this occasion, as it is for me a great honor and pleasure to address you in the name of Spain. My government takes the greatest interest in all matters relating to dental science, and as a further proof of this interest has sent beside myself, as governmental delegates, two of the greatest dental men we have in Spain, Drs. Florestan Aguilar and Dr. Luis Subirana, and it is through their courtesy and also in their names that I address you.

I have to thank you most heartily for the kind way in which we have been welcomed by the city of St. Louis, and by the Fourth International Dental Congress. We are full of admiration for your magnificent Exhibition, one of the greatest wonders the world has ever seen. This sentiment of admiration is still greater to us, coming as we do from countries which have existed almost since the prehistoric periods, as we realize that your wonderful land has accomplished in a few years—thanks to the progressive genius of the American people—that for which other countries have consumed centuries.

I am happy to say that dentistry is one of the up-to-date sciences in Spain. Our teaching of this branch compares very favorably with that of any other country, and our requirements are very high. My *confrères* in Spain are most progressive, and, of course, as in every part of the world, American systems are in vogue. Many of the young dentists from my country, knowing that America is the true spring of modern dental science and the mother of dental education, come to your land, regardless of sacrifices, with the object of improving their knowledge, and then return to the mother country usually with the American D.D.S. appended to their names.

Again I thank you for your cordial welcome, and my only regret is that I am not familiar enough with your language to be able to express well enough the sentiments of admiration and friendship from my professional brethren in Spain. (Applause.)

Dr. L. C. Bryan, Basle, the representative of Switzerland, spoke as follows:

Mr. President, ladies and gentlemen: Considering the late hour, the small spot which I represent on the map of the world, and the large number of speakers to be heard from, I will only extend to you the cordial greetings of the profession of Switzerland, and say that it is our great desire that the next dental congress may be held in our hospitable country, the playground of the world. I thank you very much. (Applause.)

Dr. HARLAN. Among those who have been appointed as official delegates to this congress you have standing before you Dr. J. Y. Crawford of Nashville, Tennessee, delegate of the United States Government. (Applause.)

Dr. J. Y. CRAWFORD. *Mr. President, dental diplomats of the world, ladies and gentlemen:* In all the experiences of my life I have never felt more profoundly my responsibility than in the duty which I am now trying to perform. I extend to you, the representatives of the nations of the earth, on behalf of the Government of the United States, our greetings, and welcome you most heartily on this auspicious occasion. The people of America, and particularly the departments of our government, whether it be the executive, legislative, or judicial, are in sympathy with the idea of gathering together at stated intervals congresses representing the various interests of the world, and we come with our congratulations, most earnestly invoking such interest and solicitude in the discussions of odontological questions at this time as will bring great benefits to the world, and result not only in the improvement of the masticating apparatus of the human family, but tend to relieve suffering humanity and add to the comfort of the population of the world. We are created upon the fundamental principle of equal rights to all and special privileges to none; we therefore enter most heartily into the business of this congress for the improvement and betterment of the condition of mankind. By the authority of the great government located at Washington, resting upon the will of the people of this great nation, we extend our most hearty congratulations. Mr. President, as the humble representative of the Government of the United States, I pledge you to do all that we can for the advancement of the interests of this congress and the profession of dentistry the world over. (Applause.)

Dr. EDWIN P. TIGNOR, representative of the Army Dental Corps, was next introduced, and spoke as follows:

Mr. President, ladies and gentlemen: It gives me great pleasure to be able to be present at this great meeting. It was a great surprise to me, and a very agreeable one. to receive the order directing me to proceed here in order to represent the Army Dental Corps, and I thank you very much for the privilege of being allowed to speak to you today.

Dr. Harlan next introduced Dr. J. M. WHITNEY, Honolulu, the representative of the Hawaiian Islands, who spoke as follows:

Mr. President, ladies and gentlemen: As I was sitting greatly enjoying the proceedings, my friend Dr. Kirk touched me on the shoulder and said, "We must hear from the baby of our republic," to which I replied, "No, you had better excuse me," but Dr. Harlan says no excuses are acceptable here. I am here not as representing the baby country, because we had an organization in Hawaii long before California was known to most of us. I was privileged to stand before you at the Second International Dental Congress, at that time as a foreigner, but now I am proud to stand before you as one of you. You are one with us and we are one with you, and I thank you for this honor. (Applause.)

Dr. HARLAN. It affords me particular pleasure, ladies and gentlemen, to be able now to present to you my old associate and collaborator in the preparation of the proceedings of the World's Columbian Dental Congress of 1893, Dr. Louis

Ottofy, the representative of the Philippine Islands. (Applause.)

Dr. OTTOFY. *Mr. President, ladies and gentlemen:* It is with the greatest pleasure that I join my distinguished predecessors upon this floor in expressing to you my sincere thanks for your most cordial welcome. I assure you that I highly appreciate the opportunity and privilege of being present to witness the erection of another milestone in the history of the progress of dentistry, a progress which may not inaptly be likened unto the progress of our great nation—a nation which during the last few years has extended her civilizing hand across the seas to a people emerging from the darkness of semi-ignorance into the bright rays of intelligence. Some idea of this influence may be formed when I mention the fact that, while I come from a territory over which wave the stars and stripes, I have traveled a greater distance to come here, excepting one gentleman from Java, I believe, than any other member of this congress.

While here with you, it shall be my sacred duty to learn all I possibly can of the advance made by our profession, and to carry back the fruits of your thought and labor to the Philippines. On behalf of the dental profession of the Philippine Islands, which I have the honor to represent, I again thank you heartily for your cordial welcome. (Applause.)

Dr. SALVADOR PRATTO was introduced by Dr. Harlan, and spoke as follows:

Ladies and gentlemen: As delegate of the Odontological Society of Uruguay I desire to express to you our most cordial sentiments of confraternity and esteem.

You no doubt know that there is a little country in the southern extremity of this hemisphere, a small country in area, but large in brains and activity, and its organization in educational lines places it at the head of the South American intellectual movement. In my country, as in all other South American republics, we carefully follow the progress achieved by dentistry in this country, without any delay save that implied by the distance which separates the two countries.

I feel a deep sense of gratification, realizing that I shall be the medium of conveying to the Odontological Society of Uruguay an account of your deliberations and a description of your operative ability and of your discoveries in the field of practical dentistry.

I am a sincere admirer of the genius of America's sons, whom I regard as the first to establish permanently the separate profession of dentistry upon an autonomous basis—thus cultivating the fruits of a plant which germinated in France, and which is now being diffused throughout the universe for the welfare of suffering humanity.

I wish to express my earnest desire for the success of this gathering, and I furthermore wish to say. that I feel proud and happy to be a member of the foreign delegation.

Dr. HARLAN. In every country with a population of five hundred thousand or over will be found installed somewhere a representative of America practicing dentistry. I have pleasure in presenting to you Dr. J. W. NOBLE of Hong Kong, China.

Dr. NOBLE. *Ladies and gentlemen:* It gives me great pleasure to appear before you this morning, and to have the opportunity to thank you for the cordial reception you have given to the members from foreign countries—with whom I feel I am included this morning—as well as to myself. I regret very much that all those practicing dentistry in my part of the world cannot be with me here today to see the progress taking place in our profession in science and art. They are missing that which we are gaining, and we can only sympathize with those who are absent from us during the present week. (Applause.)

Dr. Benjamin Vidaurre, representative from Nicaragua, was next introduced, and spoke as follows:

Mr. President, ladies and gentlemen: The Government of Nicaragua, whose duly accredited representative I am proud to be, sends greetings to the Fourth International Dental Congress. Please accept from my profession and myself sincere thanks in the name of my country for the courtesies that have been extended to me. I am glad to say that my government has always shown not only a desire, but an eagerness,. to assist in any scientific work or lend aid in any way that will further the ends of progress. Our president, on being invited, did not hesitate to send a representative of the government to the congress, and while that representative may not shed much light upon the deliberations of this body, he will endeavor to take back with him part at least of the great treasures which will emanate from this congress. Again I thank you most heartily for the cordial reception tendered me. (Applause.)

Dr. Joaquin Yela, Jr., official delegate of the Government and Dental Faculty of the Republic of Guatemala, Central America, was presented, and spoke as follows:

Mr. Chairman, fellow delegates, ladies and gentlemen: If I were to speak now in my own native tongue, very few of you, I am sure, would understand me—although, from my speaking in my broken English the number of sufferers may be greater; relying, therefore, on your own well-known patience and goodness, I will try to make myself understood in the beautiful language of Shakespeare and Longfellow.

For many reasons I could have wished that it had fallen to the lot of a delegate of greater distinction and experience than myself to respond to your very kind invitation to speak, but I do recognize that in letting your choice fall upon me you have acted, not out of regard to the special delegate, but out of compliment to the country whose government and dental faculty I have the honor, however unworthy, to represent at this congress—a country which is linked to the United States of America by so many ties both of a commercial nature and of sincere friendship.

I observe with great pleasure that there are to be discussions and conferences on many and very important dental topics which it will be for us to report to our respective governments and faculties.

It only remains for me now, Mr. Chairman and fellow delegates, to express once more my very cordial thankfulness for the benevolent reception accorded me here, and to express as well the same sentiment of thankfulness to the people of this beautiful city of St. Louis, assuring you all that I am the interpreter of the feelings of the government, faculty, and people whom I have the honor of representing in this highly distinguished assembly. (Applause.)

Dr. Ragnwald Hendricsen, Christiania, the representative from Norway, was presented, and spoke as follows:

Mr. President, and members of the Fourth International Dental Congress: On behalf of the dental profession of Norway and the Christiania Dental Society, it is with the greatest pleasure that

I greet you. Norway is the farthest northern country represented here, and although cool of climate we are warm of heart, and our profession as a whole and individually are profound admirers of American dental science. We all try to follow your methods and are eager to know more and more, and therefore have sent and are sending to your colleges many students.

The cordial, friendly spirit which you have shown to all of us foreigners will always be a delightful remembrance, and I wish to express the most sincere thanks both from myself and my Norwegian brethren.

The official representative of the Norwegian Government, Mr. Anderson, has not arrived, and I could not refrain from expressing a few words on behalf of my nation. (Applause.)

Dr. N. S. Jenkins of Dresden, Germany, was presented to the congress, and spoke as follows:

Mr. President, ladies and gentlemen: With all my heart I wish to bring to you the greetings of the body of colleagues practicing their profession under the American degree in the empire of Germany. They send to you their most cordial and fraternal greetings, and beg you to believe that they are heart and soul with you in every effort toward uplifting and carrying forward the ever-increasing influence of the great profession to which we all belong. (Applause.)

President's Address.

The President. *Ladies and gentlemen, members of the Fourth International Dental Congress:* The next order of business is the address by the President of the Fourth International Dental Congress, and as an evidence that I never really intended to preside over this body, until the election had been finally ratified on this floor, I am here today at this wedding feast without a wedding gown—namely, the "President's address." My remarks, therefore, shall be brief.

At the threshold of this great gathering of the profession from all parts of the world, I bring you the greeting of the Hon. Theodore Roosevelt, President of the United States, for a most pleasant, profitable, and successful congress. I desire also to acknowledge the courtesy and interest of his Excellency the Governor of Missouri.

To the official delegates representing foreign governments, and the representatives of dental societies in other countries, assembled here today, I extend a most cordial and hearty greeting, and beg to express the hope that their stay among us may be most agreeable and pleasant. It is a matter of sincere congratulation to welcome this splendid representation from abroad, and to be able on behalf of the profession in America to felicitate them upon their achievements in the advancement of professional interests in the various countries from which they are accredited.

We in America are pleased to note the great interest which our brethren from abroad evince in the congress, not only by their presence, but more particularly by their contributions to the excellent program which has been prepared for this meeting. We welcome them with open hearts, and cordially reciprocate the warm sentiments which they have ever expressed to representatives of the profession from America on occasions like the present.

It is indeed a pleasure to commend the enterprise, enthusiasm, and liberality displayed by state and local societies and colleges in America, in their very generous contributions to assist in defraying the necessary expenditures in preparing for this congress.

The Organization Committee also desires to acknowledge at this time their indebtedness to the Hon. Howard J. Rogers, director of congresses, for the ready and willing support which he has at all times rendered, and for his unfailing interest and solicitude in everything having for its object the complete success of the congress.

To the members of the profession in America assembled here today I bring the greeting of the authorities of the Louisiana Purchase Exposition, and that of the officers and committees in charge of the preparations for this great meeting. In point of numbers this is the largest dental congress ever held, which must be a source of great satisfaction to all our people. The program, from a literary and a scientific standpoint, has never been equaled. No such array of talent has ever before been brought together, and I am sure that the results achieved at this meeting will make an epoch in dentistry that will for many years be referred to as one of the most brilliant in the annals of the profession.

Many questions will come up for discussion, the correct solution of which will require earnest and thoughtful deliberation, and I urge upon you the necessity of cultivating a broad and liberal spirit in the consideration of the great problems with which you are confronted.

This is not the time nor the place to burden you with references to matters of history, or to treat in an academic way the great questions of the hour.

You are conversant with the early history of dentistry, the lack of sympathy and support by the medical profession, the great obstacles to proper professional recognition; the difficulties encountered by the early practitioners; the wonderful achievements with crude facilities for practice, and withal the splendid and brilliant results obtained by the great men who have shed undying luster upon the profession which they honored and served so well. The past is secure; so let us approach the duties of the hour with the same spirit of self-sacrifice and love for the profession that animated the fathers of dentistry.

I trust that every member of the congress will do his utmost to promote harmonious action throughout the various committees and sections, so that all shall work together for the complete success of the congress and the glory of dentistry. (Applause.)

The President. We are signally honored by having with us today the president of the International Dental Federation, a distinguished gentleman who is well known to all of you for his sterling qualities. and for the great ability he has shown not only as a practitioner of dentistry, but as an executive officer, and I now have the honor of presenting to you our distinguished *confrère* from France, Dr. Charles Godon of Paris, who will address you. (Applause.)

Dr. Godon. *Mr. President, ladies and gentlemen:* At this, the first meeting of the Fourth International Dental Congress, I should have liked to speak in the name of France—being one of the official delegates of the French Government and of the national federation—to recall to you all the ties of sympathy which unite our two republics. The fraternal relations existing since the time when you achieved your independence under Washington, with Lafayette and Rochambeau, are also of a professional nature, because of our common ancestors, Gardette and Lemaire, who brought over to America the French dentistry of the eighteenth century; and finally they are assured at the present time because of our common ideals of liberty, equality, and fraternity.

I left to my friend and co-delegate, Dr. Sauvez, the honor of speaking in the name of France, because I have today another duty, viz, to speak at this opening meeting in the name of an association which is above nationalities, since it is a universal association of national dental societies, a permanent international body existing in the interim of international dental congresses—in the name of this great association which you all know now as the great advisory council on dental international relationships.

The F. D. I. has taken a part in the work of this congress which for a while was surrounded by many difficulties. But now these are all over, and I bring you in the name of the F. D. I. a fraternal greeting. We can but congratulate you upon this first result, and now we turn over to you our powers, with all documents relating to the work accomplished since 1900.

The following statement, which is approved by all the members of the executive council of the F. D. I., will give you an idea of the work which has been performed:

THE INTERNATIONAL DENTAL FEDERATION.

The International Dental Federation is the child of the Third International Dental Congress. The resolutions creating it were passed on the last day of the congress. All of the representatives of national dental associations present in Paris in 1900 nominated members to be voted upon to form an Executive Council of seven or nine members, which council was to have authority to organize various commissions and also to determine the time and place for holding the succeeding congress after receiving invitations from different countries. In pursuance of its authority it met in Paris in 1900; in London and Cambridge in 1901; and organized a Commission of Education and one on Hygiene and Public Dental Service. In 1902 it voted to accept the invitation to hold the Fourth International Dental Congress in St. Louis, Mo., in August 1904. It organized a Commission on the International Dental Press at its meeting in Madrid, Spain, in 1903. At present there are three powerful commissions struggling respectively with problems of education, hygiene, and an international dental review.

The Federation is so constituted that its first period ends with the opening of the Fourth International Dental Congress, and that congress will provide for its perpetuation in the period intervening between the Fourth and Fifth International Dental Congresses.

It is within the power of the Fourth Congress to determine exactly under what rules and regulations (we present copies of rules and regulations for your consideration [see page 24]), and also the names of those who shall carry on this work if the Federation shall be continued during a second period. It is hoped that the congress in its wisdom may see fit to determine to inaugurate a second period for the Federation, and that it may be even more successful than the first.

As you will see by the official records of the sessions of the Congress at Paris, 1900; of the meetings at London and Cambridge, 1901; at Stockholm, 1902; at Madrid, 1903, and at St. Louis, 1904—which we are transmitting to your care together with a report of the secretary-general—you have a complete history of the work accomplished during our various sessions.

To conclude, let me tell you of my satisfaction in seeing that the F. D. I. has found in your great land this hearty hospitality, characteristic of the American dental profession, for which I thank you sincerely. It is with the greatest confidence that I place its destiny in your hands, quite sure that it will continue to grow and to develop, as does everything here that pertains to the progress of science and to the good of humanity.

The President. If there is no objection this report will be accepted and referred to the Committee on Resolutions.

The secretary-general, Dr. Kirk, read the following cablegram from Dr. JOHN S. BURNETT, of Salto, Uruguay:

DR. H. J. BURKHART, *president Fourth International Dental Congress, St. Louis:*

Success to the Congress. I am mentally with you. JOHN BURNETT.

Report of the Committee on Prize Essays.

The next order of business being the report of the Committee on Prize Essays, the President called upon Dr. Truman to present the report of that committee.

Dr. JAS. TRUMAN, chairman of the Committee on Prize Essays, then read the following report:

ST. LOUIS, MO., Aug. 29, 1904.

To the Fourth International Dental Congress:

The committee to whom was given the consideration of papers competing for the prize offered by the Committee of Organization begs leave to make its report to the Congress assembled at St. Louis.

Your committee decided upon the following rules for its government in considering papers presented:

1. The subject-matter must be new and original.
2. The paper must not be overloaded with quotations.
3. It must, in every respect, be in accord with the character and dignity of the Congress.

Ten papers have been presented and carefully considered. Several of these are so nearly up to the standard adopted that your committee has found some difficulty in reaching a united conclusion. It has, therefore, been regarded as proper and just, in deciding upon the paper worthy of the prize, to mention several equally worthy of "honorable mention."

The paper entitled "A Study of Certain Questions Relating to the Pathology of the Teeth," prepared by Professor W. D. Miller of Berlin, is in the opinion of your committee entitled to the highest honor that this Congress can bestow.

The prize, therefore, is conferred upon his work.

The paper entitled "The Pathology of Lime Salts in Nutrition," by Dr. Med. C. Röse of Dresden, Germany, is regarded by your committee as one of the most thorough and valuable papers ever prepared upon this subject. It presents years of patient work, but unfortunately does not, and as yet cannot, go beyond clinical observation.

Your committee, therefore, report for "honorable mention" in the order of merit, the following:

1. "The Pathology of Lime Salts in Nutrition," by Dr. Med. C. Röse, Dresden.
2. "Constitutional Causes of Tooth-Decay, Erosion, Abrasion, and Discoloration," by Dr. Eugene S. Talbot, Chicago, Ill.
3. "Anatomic Changes in the Head, Face, Jaws, and Teeth in the Evolution of Man," also by Dr. Eugene S. Talbot.
4. "The Development of the Teeth of the *Sus domesticus*," by Zahnarzt Max Hirsch, Halle.

The balance of the papers, valuable for section work, have been transferred to the proper custodians.

Two papers were sent in for examination, but both were too late to compete for the prize: One by Dr. J. P. Michaels of Paris—not in the hands of the committee and title unknown—and one entitled: "(1) Investigations Concerning the Corrosibility of Aluminum; (2) Applicability of Aluminum to Dentistry," a very full paper upon this subject, by Hof-Zahnarzt W. Pfaff, Dresden, Ger.

With sentiments of respect, we subscribe our names.

WILBUR F. LITCH,
L. M. COWARDIN,
JAMES TRUMAN,
Chairman.

On motion, the report of the Committee on Prize Essays was accepted and adopted.

The Secretary-general then read a communication from the Dental College of Sheffield, Eng., as follows:

UNIVERSITY COLLEGE, SHEFFIELD:
DENTAL DEPARTMENT.

AT a meeting of the dental practitioners held in Sheffield on Tuesday, July 19, 1904, it was unanimously decided to send their congratulations and fraternal greetings to the members in meeting assembled at the St. Louis Dental Congress.

Also: The members of the Sheffield and District Association of Licentiates of Dental Surgery have pleasure in sending their heartiest good wishes to the members of the Congress at St. Louis.

The members of the above society have delight in announcing that their honorary secretary, Mr. H. James Morris, L.D.S.Eng., will attend the Congress and in person express their hearty good wishes for a happy and successful meeting.

Geo. Henry Lodge, *President*,
Charles Stokes,
Frank Mordaunt,
Council.
H. James Morris, *Treas.-Sec'y.*

A letter from Mr. W. H. Williamson, president of the British Dental Association, to Dr. M. H. Cryer, as follows, was received too late to be read, having been delayed in transmission:

Kindly express to the officials of the Congress my great regret at my inability to be present, and at the same time convey the best wishes of the British Dental Association for the success of your great gathering.

I shall send a cable on the opening day in case this should not reach you in time.—Yours sincerely, W. H. Williamson.

The President. If there be no objection the secretary-general is instructed to reply to all telegrams and letters to the congress.

There being no other business before the congress, the President declared the meeting adjourned until Tuesday morning at 10 o'clock.

[Presented by Dr. Godon for the F. D. I.—See page 22.]

Rules and Regulations of the International Dental Federation.

Approved by the Fourth International Dental Congress, St. Louis, Mo., 1904.

Statuts.	Preamble.
(a) La Fédération dentaire internationale est une association ou union universelle des fédérations dentaires nationales et des sociétés ou groupements dentaires qui lui ont donné leur adhésion.	(a) The International Dental Federation is an association or universal union of national dental societies and those affiliated therewith.
(b) Elle a pour titre "Fédération dentaire internationale" et en abrégé "F. D. I."	(b) The official title adopted is "Fédération Dentaire Internationale," abridged "F. D. I."
(c) La Fédération dentaire internationale est la commission permanente internationale servant de lien entre les congrès dentaires internationaux.	(c) The International Dental Federation is a permanent international body existing in the interim between international dental congresses.
(d) Elle est administrée par un Conseil exécutif composé de délégués représentant les divers pays. Ces délégués seront nommés par	(d) It is governed by an Executive Council. composed of delegates representing different countries (receiving appointment from

le congrès précédent. Le Conseil organise les diverses commissions jugées utiles pour faciliter le progrès de l'art dentaire à tout point de vue. Il est en même temps un comité consultatif international dentaire.

(e) La F. D. I. se réunit en assemblée générale avant l'ouverture des congrès dentaires internationaux.

(f) Le Conseil exécutif et les commissions se réunissent tous les ans. La ville et l'époque à laquelle ces réunions auront lieu seront fixés à la clôture de chaque session.

(g) Veux adoptés par le 3ème Congrès dentaire international de Paris (1900) dans l'assemblée générale du 14 Août, créant la F. D. I.:

“11. Qu'il soit créé une Fédération dentaire internationale.

“12. Que les Comités nationaux formés en vue du Congrès actuel continuent d'éxister et constituent la Fédération dentaire internationale.”

Règlement.

Article I. La Fédération dentaire internationale, constituée par l'union des comités nationaux formés en vue du 3ème Congrès dentaire international de Paris, a été crée en conformité des vœux No. 11 et 12 émis par l'assemblée générale de clôture du 14 Août 1900 du dit congrès.

Art. II. La Fédération a pour but:

(a) L'acceptation ou le rejet des invitations faites par les divers pays de tenir un congrès dentaire international; la fixation du lieu et de la date de ce congrès.

(b) Le maintien et l'augmentation des liens qui rattachent les divers comités nationaux les uns aux autres.

(c) L'organisation des diverses commissions internationales qu'elle jugera utile de créer.

(d) D'une manière générale, l'organisation de tout ce qui peut contribuer à l'avancement

the preceding congress). This Council organizes various Commissions that it deems will be beneficial to the advancement of dental science in any of its phases; it is at the same time an advisory committee on international affairs.

(e) The F. D. I. will hold a general meeting preceding the opening of each international dental congress.

(f) The Executive Council and the various Commissions will hold annual meetings. the time and place to be selected at the close of each meeting.

(g) *Authority creating the F. D. I.:* Resolutions passed by the Third International Dental Congress (Paris, France), August 14, 1900, viz:

“11. There shall be organized an International Federation.

“12. The national committees appointed to this Congress will continue in office and will constitute the International Dental Federation.”

Rules and Regulations.

Article I. The International Dental Federation was organized by the national committees present at the Third International Dental Congress, at Paris, in 1900, and was created in conformity with Resolutions 11 and 12 passed by the general meeting on the closing day of that Congress, August 14, 1900.

Art. II. The objects of the Federation are as follows:

(a) The acceptance or rejection of invitations made by various countries to hold a regular International Dental Congress, and to fix the date and place where such congress shall be held;

(b) To maintain and strengthen the ties that bind the national societies to each other;

(c) The organization of such International Commissions as it may deem necessary to create;

(d) In a general way, to promote the organization of bodies that will contribute de la science odontologique dans le monde entier.

Art. III. La Fédération dentaire internationale est composée:

(a) De tous les comités nationaux constitués en vue du Congrès dentaire international de 1900 ou de leurs successeurs.

(b) Des fédérations ou sociétés adhérent aux congrès dentaires internationaux et acceptant ce règlement ou envoyant leur adhésion.

(c) Des sociétés ou fédérations de sociétés qui, par la suite, enverront leur adhésion aux présents statuts et règlement et seront acceptés par le Conseil exécutif.

Art. IV. Les fédérations nationales de sociétés ou, à leur défaut, les sociétés ou praticiens qui désirent faire partie de la F. D. I., doivent envoyer leur adhésion aux présents statuts et règlement. Cette adhésion est examinée par le Conseil exécutif, qui prononce l'admission.

Art. V. L'assemblée générale de la F. D. I., composée des délégués des diverses fédérations ou sociétés, se réunit avant l'ouverture de chaque congrès dentaire international. Elle peut être réunie par le Conseil exécutif en assemblée extraordinaire, en cas de nécessité.

Art. VI. Le Conseil exécutif pourra admettre comme membres de la Fédération—

(1) Des membres régulièrement délégués par les sociétés.

(2) Des membres honoraires.

(3) Des adhérents libres à la F. D. I. ayant été membres d'un congrès dentaire international, et qui enverront leur adhésion aux présents statuts et règlement.

Art. VII. L'ordre du jour de ces réunions sera fixé par le Conseil exécutif. Il porte sur les propositions émanant soit des fédérations dentaires nationales ou, à leur défaut, des sociétés, soit du Conseil exécutif, et il est communiqué aux fédérations ou sociétés participantes au moins un mois à l'avance.

Art. VIII. Le vote a lieu par délégué régulier. Sur la demande des représentants d'au

to the advancement of odontological science throughout the world.

Art. III. The International Dental Federation consists of—

(a) All the national committees gathered in Paris in 1900, or their successors;

(b) Associations or societies giving their adhesion to international dental congresses, and accepting these Rules and Regulations or sending their concurrence in them;

(c) Societies, or groups of societies, which may officially signify their acquiescence in these Rules and Regulations and which are acceptable to the Executive Council.

Art. IV. National dental associations or societies, or, in the absence of such, persons desiring to become identified with the F. D. I., should send their acceptance of the present Rules and Regulations. Such applications will be acted upon by the Executive Council, who will accept them as members of the Federation.

Art. V. The general meeting of the F. D. I. will take place before the opening of each international dental congress. It will be composed of delegates from national or other societies. Extraordinary meetings may be called for special reasons by the Executive Council.

Art. VI. The Executive Council may admit as members of the Federation—

(1) Members regularly appointed by societies.

(2) Honorary members.

(3) Persons in good professional standing who have been members of international dental congresses, and who shall subscribe to these Rules and Regulations.

Art. VII. The program for these meetings will be prepared by the Executive Council. It will deal with matters emanating from national or other societies, or with questions proposed by the Council. Notices will be sent at least one month before these meetings to all affiliated societies, national or local.

Art. VIII. The right of voting pertains to regularly appointed delegates. Upon the remoins deux fédérations, le vote pourra avoir lieu par fédérations nationales, un vote pour chaque pays.

Art. IX. Les réunions annuelles du Conseil exécutif et de ses commissions sont réglées par les articles précédents.

Art. X. La F. D. I. est réprésentée par un Conseil exécutif composé comme suit:

(1) Cinquante membres titulaires choisis par le congrès, à raison d'un membre pour chaque pays adhérent au minimum, et de cinq au maximum.

(2) En cas de vacance, par suite de démission, décès, ou de toute autre cause, le Conseil demandera à la fédération nationale représentée de pourvoir au remplacement du membre manquant.

(3) Les pouvoirs de Conseil expirent à l'ouverture de chaque congrès dentaire international.

(4) Le Conseil remettra à une commission speciale nommée par le congrès ses documents et rapports à l'ouverture des congrès internationaux. Cette commission accusera réception par écrit des documents reçus.

(5) Le trésorier de la F. D. I. continuera à exercer ses fonctions jusqu'à l'élection de son successeur.

Art. XI. Le Conseil est administré par un bureau ou commission permanente de neuf membres, savoir:

(1) Un président.
(2) Trois vice-présidents.
(3) Un secrétaire-général.
(4) Trois secrétaires.
(5) Un trésorier.

Le bureau du Conseil fait partie de droit de toutes les commissions, et les dirige jusqu'à la constitution de leur propre bureau.

Art. XII. Le Conseil exécutif a pour mission—

(a) De veiller à l'exécution du règlement de la Fédération.

(b) De fixer le lieu et la date des réunions internationales annuelles et des congrès internationaux.

quest of representatives of at least two national dental associations, the vote may be taken by the said regularly appointed delegates in the mode of one vote for each country.

Art. IX. The annual meetings of the Executive Council, and of the various Commissions, are governed by the preceding Rules and Regulations.

Art. X. The F. D. I. is composed of an Executive Council, as follows:

(1) Fifty original members, chosen by the congress—that is to say, for each country as a minimum, one member, with a maximum of five members;

(2) In case of vacancy, by resignation, death, or other cause, the Council will ask the respective national dental association to fill the place of the missing member.

(3) The powers of the Executive Council will expire upon the opening of each international dental congress.

(4) The Council will hand over to a special committee appointed by the congress all of its documents and records, at the time of the opening of the congress, said committee receipting for the same.

(5) The treasurer of the F. D. I. will hold office until his successor is appointed.

Art. XI. The Council is governed by nine Officers, as follows:

(1) A president.
(2) Three vice-presidents.
(3) A secretary-general.
(4) Three assistant secretaries.
(5) A treasurer.

The officers of the Council are *ex officio* members of all Commissions, and will direct them until they are properly organized.

Art. XII. It is the duty of the Executive Council—

(a) To supervise the execution of the Rules of the Federation.

(b) To fix the place and date of annual meetings, and of International Dental Congresses.

(c) De réunir les diverses commissions internationales.

(d) De poursuivre l'exécution des décisions prises par la F. D. I.

(e) D'examiner les propositions ou résolutions qui lui sont soumises par les comités nationaux, fédérations, ou sociétés.

Le Conseil tient les diverses fédérations dentaires nationales au courant de ses travaux par le Bulletin du Conseil exécutif de la F. D. I., qu'il publira en quatre langues: français, allemand, anglais, et espagnol.

Art. XIII. Le Conseil a dejà nommé les diverses commissions spéciales qui lui paraissaient nécessaires:

(1) Commission de l'Enseignement dentaire.

(2) Commission d'Hygiène et des Services dentaires publics.

(3) Commission de la Presse dentaire internationale.

(4) Commission de Jurisprudence professionelle, etc.

Le Conseil organisera une commission de Déontologie et une de Nomenclature.

Art. XIV. Les ressources de la F. D. I. sont constituées—

(1) Par les cotisations annuelles de ses membres, qui sont:

Pour les membres du Conseil exécutif, de 50 frs.
Pour les membres des commissions, de 25 frs.
Pour les membres honoraires ou libres, de 25 frs.

(2) Par le reliquat des caisses des congrès dentaires internationaux.

(3) Souscriptions, dons ou subventions des gouvernements, municipalités, fédérations nationales, ou individualités.

Art. XV. En cas de déficit, les dépenses de la F. D. I. seront supportés en parties égales par les fédérations ou sociétés adhérents. L'excédent sera versé à la caisse du congrès dentaire international suivant. Le Conseil exécutif soumettre ses comptes à chaque congrès dentaire international.

Art. XVI. Le Conseil exécutif enverra au

(c) To organize various International Commissions.

(d) To supervise the carrying out of decisions made by the F. D. I.

(e) To examine propositions and resolutions offered by national committees, associations, or other societies.

The Council will keep all affiliated bodies informed of their work through the Bulletin of the Executive Council, which will be published in at least four languages, viz, French, German, English, and Spanish.

Art. XIII. The Council has already named several special Commissions, as follows:

(1) A Commission on Education.

(2) A Commission on Hygiene and Public Dental Service.

(3) A Commission on International Dental Press.

(4) A Commission on Dental Jurisprudence.

And it will organize Commissions on Deontology and on Nomenclature.

Art. XIV. The sources of income of the F. D. I. are as follows:

(1) By dues from the members, to wit:

Members of the Executive Council, ten dollars per annum.
Members of Commissions, five dollars per annum.
Honorary members and all others, five dollars per annum.

(2) Appropriations by congresses.

(3) Subscriptions, gifts from governments or municipalities, from national associations, and from individuals.

Art. XV. In case of deficit, the expenses of the F. D. I. shall be provided for by equal assessment on all societies having membership. Any excess above the receipts will be turned over to the next dental congress. The Council will give a detailed statement of receipts and expenditures to every congress.

Art. XVI. The Executive Council will

Congrès une liste des membres les mieux qualifiés pour suivre les travaux de la F. D. I.

Art. XVII:

(1) Les congrès dentaires internationaux seront organisés par une commission de dentistes choisis de la façon suivante:

Un tièr du nombre de cette commission sera nommé par le Conseil exécutif de la F. D. I.; les autres deux tièrs seront nommés par les groupement faisant l'invitation. Cette commission constitura la commission d'organisation. et tous ses membres auront les mêmes pouvoirs.

(2) A sa première réunion la commission d'organisation nommera un bureau composé d'un président, deux vice-présidents, un secrétaire-général, un trésorier.

(3) Le Conseil exécutif de la F. D. I. aura le pouvoir de décider toute question qui pourrait se développer dans la commission d'organisation.

Art. XVIII. Le présent règlement est adopté pour la période comprise entre deux congrès dentaires internationaux réguliers. Il peut être révisé au congrès suivant.

send to the congress during its sessions a list of those members best qualified to carry on the international work of the F. D. I.

Art. XVII:

(1) International dental congresses shall be organized by a committee composed of dentists, who shall be chosen as follows:

One-third of its membership shall be appointed by the Executive Council of the F. D. I.; the other two-thirds shall be appointed by the inviting dental bodies. The committee so composed shall constitute the Committee of Organization, all the members of which shall have the same powers.

(2) At the first meeting of the Committee of Organization they shall organize and select the following officers of the committee: A president; two vice-presidents; a secretary-general; a treasurer.

(3) The Executive Council of the F. D. I. has full power to decide all questions in dispute arising in the Committee of Organization.

Art. XVIII. These Rules are operative during the periods between regular congresses. They are subject to revision by the succeeding congress.

SECOND GENERAL SESSION—Tuesday, August 30th.

The second general session was called to order at 10 o'clock Tuesday morning by the president, Dr. H. J. Burkhart.

The PRESIDENT. Ladies and gentlemen, I have the pleasure of introducing to you the first member of the Fourth International Dental Congress, Dr. A. G. Weber, of Havana, Cuba. (Applause.)

Dr. A. G. WEBER. *Mr. President, ladies and gentlemen:* Our president has been extremely kind in honoring me with this introduction, and I have no words to express my deep appreciation for his kindness. Although coming from a small and new nation to this grand congress in this great country, it is natural for me to respond; for everywhere—no matter where—dentists will respond promptly to the call of "dentistry." I think that I ought not to make a long speech this morning, as your time is valuable and it might be somewhat intrusive. Ladies and gentlemen, I thank you very much for your kind attention.

The PRESIDENT. The first paper of the program this morning is one reported from Dr. Brophy's section, entitled "*A propos* of a Portrait of Pierre Fauchard," by Dr. George Viau of Paris, France, which will be read by Dr. Brophy.

Dr. John E. Grevers, Amsterdam, Holland, honorary president, was called upon to occupy the chair during the reading of Dr. Viau's paper.

Dr. BROPHY, before reading the paper, made the following remarks:

Mr. President, ladies and gentlemen: I have a letter from the author of this paper informing me that he has forwarded to this place a large oil portrait of the distinguished Frenchman whose memory we all revere, and it is to be placed upon the stage. It has not yet arrived, however, and in the meantime I have placed this one before you [exhibiting portrait] in order that we may have his likeness before us during the reading of the paper. As the president announced, the paper is by Dr. GEORGE VIAU, professor in l'École Dentaire de Paris:

[Transferred from Section IX.]

A propos of a Portrait of Pierre Fauchard.

By Dr. GEORGE VIAU, Paris, France.

There are certain names which, so to speak, represent either an epoch, a science, or an art. To dentistry that of Pierre Fauchard is one of these epoch-making names.

There were many dentists before him, and the city of Paris as early as 1700 had already established regulations by virtue of which no one was allowed to practice without having obtained a certificate as being an expert dentist, which certificate was granted after the candidate had submitted to an examination before a commission of three surgeons appointed by the municipality. But the subject of this examination included such extraordinary theories and such brutal practices that the art of dentistry was relegated to the lowest type of surgeons, who were looked down upon as practicing an art very inferior to medicine.

Pierre Fauchard, in eliminating from our profession a quantity of absurd practices, in relying only upon well-observed clinical facts for his technique, in knowing how to draw logical deductions from these—in one word, in being in advance of his time by the introduction into our art of the experimental method—could have completely transformed the dentist's art of his period, had he had more pupils and had the teaching of his books broken down the formidable barrier which at that time opposed all progress. Nevertheless, his influence, though less than it ought to have been, was not null, and his work continued to be one of the principal foundations upon which was built the variety of information now required of the educated and experienced practitioner.

We therefore, no matter to what nation we may belong, can look upon him as a precursor of our present advanced methods.

Humanity honors itself by commemorating and glorifying those who have aided by their energy and genius to pass the hard stages of ancient times, when all progress was considered as an attempt against the existing order of things, consecrated by superstitions and time-honored traditions.

Pierre Fauchard, whose début in life was most difficult, but who, in spite of all, succeeded even during his lifetime in arriving at prominence, was an energetic worker, and we can but honor ourselves in preserving his memory, for he was the greatest among those who have traced the path which we are now treading.

My much-regretted friend, Dr. Louis Thomas, librarian of the Faculty of Medicine of Paris, at a conference on the occasion of the inauguration of the Dental School of Paris in 1880, by learned research resuscitated for us, so to speak, the great figure of our illustrious colleague.

Born in Brittany toward the end of the seventeenth century, and destined by his parents for the practice of surgery, Fauchard was at first prevented by family troubles from following his vocation; but Providence took care that he should not escape the destiny of a master in one of the branches of the art of healing.

In organizing the navy, Colbert instituted a health service. This was not strict in its entrance requirements, and it was thus that Fauchard, after having unsuccessfully tried several mechanical professions—the practice of which, however, proved to be not without value to him later on—was able to enter, as assistant, one of these services. He there had the good fortune to have as his chief Alexandre Poteleret, surgeon-major of the king's navy, who had especially interested himself in affections of the mouth, and more especially in scorbutic disorders, which at that time were frequent on sailing vessels making long cruises. This happy chance decided the future of Pierre Fauchard, who was already interested in the little he had been able to learn of this specialty, and more particularly in all that his ingenious mind suspected was yet to be discovered therein. His service in the marine corps did not continue long, and in 1700 he took up residence in the university town of Angers.

At this period the dentist's services were little in demand, and it was necessary for the few existing practitioners to travel from town to town in order to make a livelihood. Owing principally to this, and also to his now growing notoriety, Fauchard visited at fixed dates the cities of Tours, Rennes, and Nantes; later he traveled as far as Paris.

At first acting as dentist to the needy population, as the remarks in his book prove, he gradually succeeded in securing a more select and lucrative *clientèle*. The boldness of the practitioner increased according to his social elevation. At first he only attempted the cleaning and extraction of teeth; later on he practiced trephining, cauterization of the pulp, and even transplantation from one mouth to another.

He acquired fame, and people came to seek him from the depths of Brittany. He determined to test his success on a larger scale, and in 1719 moved to Paris.

The most renowned dentist of the town was Carméline, the king's dentist, and of him he made a friend. He also made friends in the College of Surgery, in the Faculty of Medicine, and even amongst the doctors of the court. Two years later he counted amongst his patients some men of standing. De Jussieu, Louis Petit, Helvétius, La Peyronnie, Hecquet, professors of the Faculty or illustrious doctors, held him in such high esteem that they recommended their patients to him and even consulted him in certain cases pertaining to his specialty.

His success and the experience he had acquired incited him to the desire, common to all, that his name should survive by making his successors benefit by the knowledge of a science and of an art he had renewed or created, for before his time there was no book worthy of such a name.

It was in 1723 that the first edition of his treatise appeared in French, and it was read and commented upon even abroad. In 1736 it was translated into German. This incident gives an idea of its importance, as the pedantic doctors beyond the Rhine up to that time accepted only works written in Latin. From the date of the publication of his book the Breton dentist acquired a scientific standing which he had not previously enjoyed, and a recognition which might, at that time, be considered universal. This position could not be weakened even by the bitter controversy that Croissant de Garengeot, a studious man, disdainful of those whose reputation sprang rather through quick-wittedness, carried on unequally against him.

In 1746 the second edition of his work appeared, with additions as the results of his long experience. One is sometimes astonished in reading this remarkable work at the prescience which the author displays in regard to certain processes in the treatment of teeth. And one is also astonished that his immediate successors profited so little from it, and that it was necessary to wait until almost the present time before connecting the thread of these discoveries, which have as a basis the destruction of the pulp and antisepsis of root-canals.

In short, one finds in Fauchard's writings information regarding operations on the destruction of the vital organ of the teeth by the hot iron and the extirpation of pulp débris with a fine stiletto. He was the first to understand the danger of leaving this débris under a filling; he was also the first to make use of antiseptics before the word was known or employed, by advising dressings of essence of cinnamon, which is now regarded as a first-class antiseptic.* He thus anticipated the use of modern antiseptic methods—which a more attentive and intelligent reading of his work might have caused to be employed a century sooner.

In addition to these discoveries, we owe to him numerous clinical observations and the description of ingenious surgical apparatus and systems of making artificial teeth.

Pierre Fauchard died at his residence in the rue des Grands Cordeliers on the 25th of March 1759, after a long and fruitful life. He had all the qualifications for a school executive—common sense, clearness of style, boldness, and ingenuity. Unfortunately for us, as I said before, he had no pupils who could have treasured his scientific learning and practical experience, and it was not until much later that the broken chain was reunited; it was not even until the present day, after all the modern discoveries had been made, that the importance of Pierre Fauchard's work can be judged at its right value. Its importance is such that it may be compared to that of Ambroise Paré's studies in general surgery.

The knowledge of physics and morals of our great predecessors should be a subject of perpetual study for us. It will easily be understood after having read the foregoing that one of the joys of my life was to discover an authentic portrait of Pierre Fauchard.

I will here describe how I became the possessor of this precious historical document on the art of dentistry in France: This portrait previously formed part of Dr. Cusco's collection, which contained a great number of portraits of surgeons and doctors of the seventeenth and eighteenth centuries. I knew Dr. Cusco and had had the opportunity of viewing his collection which contained, besides portraits, instruments, and apparatus of ancient surgery and a remarkable library. I must say that I had not particularly noticed the portrait in question, which makes me suppose that Dr. Cusco himself did not realize to what extent this work of art would interest our profession, otherwise I think he would have pointed it out to me.

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* See Fauchard, 2d edition, vol. i, chap. x.

Upon Dr. Cusco's death there was a sale at the Hotel Druot, in which I was interested, knowing the rarities contained in his collection, and it was thus that in seeking to know the names of the portraits I discovered at the back of one of them, written on the canvas,

Pierre Fauchard
1726

—while higher up on the wooden frame was a name probably that of the painter Netscher.

In several encyclopedias Fauchard is simply designated as a surgeon who was born in Brittany at the end of the seventeenth century and died in Paris in 1759; it is not astonishing, therefore, that he should merely have figured as such in this collection of surgeons and doctors of that epoch.

This portrait painted in 1726 represents P. Fauchard younger than that reproduced in the engraving of the second edition of his book published in Paris in 1746. In these two portraits he is represented in a costume almost identical, and in the same attitude; the portrait in the book was engraved by J. B. Scotin after J. LeBel. The original of this last portrait unfortunately is not known, but from the engraving one can easily compare it with the painting, and in spite of the years intervening between the dates at which they were made we discover a resemblance of the principal features: a long, thin face, high forehead, long straight nose, large eyes, expressive and intelligent, with the arched eyebrows well accentuated.

Is not that the picture of an intelligent and energetic man, corresponding with what we know of the intellectual and moral qualities of our illustrious colleague?

Discussion.

Dr. BROPHY. The Secretary-general has requested me to announce that this oil painting of our distinguished ancestor will be placed on exhibition in the Section on Education, Nomenclature, History, and Literature, which occupies the room at the extreme west end of the second floor of this building, at 2.30 this afternoon.

The PRESIDENT. This paper is now open for general discussion, and I desire to inform the members of the rules of the congress regarding discussions and debate. The person opening a discussion is allowed ten minutes, those taking part in the general discussion will be allowed five minutes, and five minutes will be allowed the author of a paper to close the discussion. I desire to state also that the time limit will be strictly enforced.

Dr. A. H. THOMPSON, Topeka, Kans. I have always been impressed with the study of the early workers of the profession, who brought dentistry out from chaos and gave it something of the standing and form which has led up to modern dentistry as we have it today. There is always an inspiration in the work of these early pioneers who were men of genius. When we study their lives we feel an uplifting influence which carries us upward and forward and makes us proud of our profession. These early men deserve great credit for what they did in their day. They brought dentistry out of chaos and laid the firm foundation of our profession; they did work of which they probably did not themselves fully understand the importance and realize the meaning, but we all know now what they did, and we are proud of them. The many historical names that have come down to us, show us what men can do who have the genius but had little in their environments to aid them. We are accustomed to saying that genius and environment is what makes men great. But this cannot be said of these men, because they had the genius and made their own environments, and laid the foundations upon which modern dentistry is built. I have always thought that men of those days ought to be an inspiration to the young men in our profession, as it shows what can be accomplished by earnest, devoted work. Even in our day there is work to be done by men of genius, but these have something to guide them—they have the environments and the foundations, but the men who laid these foundations are the men we honor today. These early historical days are very interesting, and the lives of the men of those days are profitable and valuable for us to study. In all these instances we are made to consider what men can do who earnestly give themselves to such a life, and we feel very grateful to Dr. Viau for having unearthed this portrait. (Applause.)

Dr. Wm. H. Trueman, Philadelphia, Pa. As members of the dental profession we cannot too greatly appreciate and honor the illustrious Fauchard, the first in the world's history to write a fairly complete text-book on dental science. We have an insight to his character when he tells us in the preface to his woik how deeply he regretted that none of the many competent practitioners of the art had published for the benefit of those who should come after them their experiences and observations, and that thus the knowledge they had acquired was lost to the world. In an effort to remedy this, after about twenty years' experience in the practice of dental surgery, he began his great work, "The Surgeon Dentist." This he completed about 1723, but delayed its publication for revision and correction until 1728. Although many treatises upon the teeth and their diseases had been published, either as separate volumes or as part of a medical work, this was the first to fully cover the whole field, and the first to minutely describe the various operations of surgical and prosthetic dentistry. It was, indeed, the first work written by a dentist for the information of dental students.

We honor Fauchard, not for his great skill, skilful as he undoubtedly was, and well versed in all that is embraced by the term "dental surgery." In this he may have been equalled, perhaps excelled, by some of his compeers whose names have long been forgotten. We honor him for the noble and unselfish spirit which prompted him to this task, and for the earnestness displayed in making known to his compeers and freely placing at their disposal all that he had learned, and all that he could persuade others to impart that might be helpful to them in their daily practice. His work inaugurated a new era. Fellow practitioners, inspired by his example, ceased to be competitors and became compeers, each anxious to help the other to increase their own usefulness and the usefulness of their calling. In the eight hundred and fifty fully written pages, and forty full-page illustrations of the "Surgeon Dentist," Fauchard gave to his profession a text-book that for completeness, accuracy of description, and frankness in describing operations and appliances, long remained without a peer. "If I have failed to make the matter plain and easily understood," he writes, "it has not been from a desire to withhold information, but rather an unintentional failure to use the proper words." It was this fraternal spirit, an entire absence of all selfish motives, and an earnest desire to better and make the profession of his choice more useful to the community that made Pierre Fauchard a great man.

Like many other progressive men, however, he had long to wait before his work and his motives were fully appreciated. A motto added by the artist to Fauchard's portrait forming the frontispiece to the German edition of his work published in 1733, a portrait undoubtedly engraved from the original painting referred to by Dr. Viau, evidently refers to this. It reads—

> Whilst Fauchard with wise hand and pen
> For health and beauty of the teeth contends,
> Envy's mad tooth is gnashed in vain;
> His noble nature treats it with disdain.

The work so well begun by Fauchard was taken up by Mouton, Lecluse, Bourdet, Jourdain, and other of his countrymen, so that before the science had been transplanted to our shores, the whole field of dental science as we know it to-day was fully compassed by talented French writers. None, however, attempted to compete with Fauchard; they were content to write upon some one subject in which they were especially interested. It is much to be regretted that the dental pioneers of our own country were not sufficiently versed in the French language to have availed themselves of this rich fund of practical information. Being an English-speaking people, it remained to us a sealed book, until by the lapse of time it ceased to have other than historic value.

I am very glad, Mr. President, that this original portrait of Pierre Fauchard has been discovered, and that a faithful copy has been sent to this country by Dr. Viau. No more fitting time or place could have been selected for presenting the portrait to the profession than at this, the largest international dental congress ever assembled. Pierre Fauchard inaugurated the spirit of professional fraternity which, growing with the passing years, made this grand meeting possible. All honor to Fauchard, and to his noble and generous countrymen! (Applause.)

Dr. CHAS. GODON, Paris. *Mr. President and members of the Fourth International Dental Congress:* I am greatly pleased that my *confrère* of Paris found this new picture of our great ancestor Pierre Fauchard, whom we call in Paris the father of French dentistry. I think that dentistry as a scientific profession began with the first book, the first journal, the first society, and the first school, as I stated in my work on "l'Evolution de l'Art Dentaire," and I am proud that we have the honor to have had the first book on dentistry by a dental surgeon, Pierre Fauchard, who wrote it in 1728, the first edition being called "Le Chirurgien Dentiste." We are interested in knowing that the first school was established in Baltimore in 1839, and that the first journal and society were likewise organized in America in 1839, and so I think it very interesting for us to know many things about that eminent man who took the first steps in scientific dentistry. I am very proud to have been delegated with my friend Dr. Sauvez to bring these pictures to you from our *confrère* Dr. Viau—one to be presented to Dr. Kirk, dean of the Department of Dentistry of the University of Pennsylvania, and the other to Dr. Brophy, dean of the Chicago College of Dental Surgery. (Applause.)

Dr. J. E. GREVERS, Amsterdam, Holland. *Ladies and gentlemen, members of the Fourth International Dental Congress:* It was with great pleasure that I listened to the communication of Dr. Viau, and certainly I was pleased to see the original portrait of Pierre Fauchard. Those who delight in reading old books will appreciate the communication of Dr. Viau, and I thank you for the opportunity given me at this time to tell you that I read the first edition of Fauchard's work with the greatest pleasure, and that I received from it much information. You have no idea what a source of information is found in this book, and it is particularly interesting to observe in the introduction to his book a delineation of what the dentist should be personally and in his habits. This book has been for these long years a source of information to all who have read it. You will find that his successors Bourdet, Delabarre, and others have largely used this book to give information to their readers. Of course, the pictures of his instruments and demonstrations are crude, but I find in the book very fine pictures of anomalies of the teeth, and it is marvelous with what perspicacity Fauchard has taken into consideration everything demanded in dentistry.

As Dr. Godon stated, Fauchard's first book was entitled "Le Chirurgien Dentiste." In this work he speaks of filling teeth, and gives pictures of instruments. Fauchard must have borrowed from older writers, for you know that Arculanus was the first to mention the filling of teeth with gold. Fauchard also mentioned the filling of teeth with gold. The extraction of teeth was practiced at that time perhaps very much the same as it is now. We find in Fauchard pictures of forceps that are the precursors of the forceps invented by Tomes later on. His chapter on artificial teeth is very interesting, and you will find in this book what is now called crown and bridge work and pivot teeth. The diseases of the teeth were closely watched by him at that time, and his descriptions of the many observations on dental diseases are worth reading. I feel with Dr. Trueman that it is a great pity, when many old writings were republished by the American Society of Dental Surgeons, that we should find the book of Delabarre translated while the work of Fauchard has been neglected. It is a great pity, and I dare say that if the book of Fauchard were translated into English you would all highly appreciate it. (Applause.)

Dr. B. L. THORPE, St. Louis, Mo. I am much pleased that this contribution to dental literature has been brought before this congress. There is no question that Fauchard has a very prominent and unique place in the history of the dental profession. He has stood out pre-eminent as the man who was the progenitor of modern dental surgery, and the influence of his work has been handed down to us through the pioneers that I referred to yesterday, who came to America at the time of the Revolution, and these men—Lemaire and Gardette—following the teaching of Fauchard, were the men who introduced dental surgery into America. Fauchard was a medical man, as the paper states, and he was the one who gathered the scattering fragments, as it were, of dental knowledge and inaugurated the dento-surgical section of the medical profession. His name is the most prominent of any European as a pioneer. He has occupied in Europe the same position that Hayden and Harris have since occupied in America, and I am pleased to know that Dr. Viau, has gathered this historical data and the portrait and presented it here. It is something which to my knowledge has never before been presented before the dental profession, an historical and biographical review of the life and works of Pierre Fauchard. (Applause.)

Dr. T. W. **Brophy**, Chicago. Mr. President, I have nothing to say further than, like my friends, to express my appreciation of the services of Dr. Viau in taking the great pains he has in gathering up this information bearing upon the life of this Frenchman and presenting it to the Fourth International Dental Congress. We all appreciate very much this work of his, and we are glad to have placed in the literature of this great congress matter of so much importance to us. It makes us feel proud of our profession, and it stimulates us to go forward and do the best we can to carry it on to a higher plane. (Applause.)

Dr. E. C. **Kirk**, Philadelphia. Mr. President, I may perhaps exaggerate it in my own mind, being especially interested in this question of dental history, but it does seem to me that the finding of this portrait and bringing it before this audience with a more accurate knowledge of the life-work and history of Pierre Fauchard is an act to be signaled by something more than the mere discussion of the paper. And I therefore move that the congress pass a vote of thanks for the pains that Dr. Viau has taken in gathering this data, and for the opportunity he has given us to review in our minds the history of this illustrious man.

The motion was carried, and the congress extended a rising vote of thanks to Dr. Viau for his contribution.

Dr. B. L. **Thorpe**, St. Louis. *Mr. Chairman, ladies and gentlemen:* It is with great regret that we have been informed that one of the local members of the Reception and Arrangements Committee has had the misfortune to lose one of his children by death yesterday, and I move, Mr. Chairman, that the Fourth International Dental Congress extend to Dr. and Mrs. J. G. Pfaff our sincere sympathy upon their bereavement.

Motion carried.

Dr. A. W. **Harlan**, New York. Mr. Chairman, one of the honorary presidents of this congress, Dr. E. A. Bogue of New York, met with the misfortune a few days ago of injuring his leg, and has had to have it amputated, consequently he cannot be present at this meeting; I think it would be proper and fitting for this congress to send a message of sympathy to Dr. Bogue in his misfortune, and I therefore make a motion to that effect.

Motion carried.

The **President**. The next order of business is the reading of a paper by Dr. John S. Marshall, and I take great pleasure in announcing that Dr. Chas. Godon, honorary president of this congress for France, will occupy the chair during the reading of Dr. Marshall's paper.

Dr. **John S. Marshall**, of the United States Army dental corps, president of the examining and supervising board of dental surgeons for the United States army, then read his paper, as follows:

The United States Army Dental Corps.

By JOHN S. MARSHALL, M.D., San Francisco, Cal.,

PRESIDENT OF THE EXAMINING BOARD OF DENTAL SURGEONS FOR THE U. S. ARMY.

Mr. President, members of the Fourth International Dental Congress, ladies and gentlemen: It is my pleasing duty to invite your attention today to a subject which was suggested to me by the secretary of your Committee of Organization as a fitting theme for this occasion, namely, the United States Army Dental Corps—a subject which he assured me was of great interest to the American members of the congress and also to the members and our guests from foreign countries, but more particularly to those who are interested in the establishment of similar organizations in the armies of their own countries. I shall therefore endeavor to place before you such facts in relation thereto as will give you an intelligent idea of this branch of the medical service of the United States army. Before placing these details before you, however, I desire to invite your attention for a few moments to certain well-established scientific facts in relation to the prevalence of dental diseases among civilized nations, and also certain other facts gained from observation and experience in military dental practice relative to the great need of the services of dental surgeons in the United States army. I also believe, judging from reports coming from British and German military authorities, there is equal need of such services in those armies, and I have no doubt, if the facts were known, similar need would be found to exist in all the armies of the civilized world.

It is a fact generally admitted by dental pathologists and practitioners that dental caries and its sequelæ are the most common diseases of the human race, and that these diseases are constantly increasing in prevalence, particularly among civilized nations; and as further proof of this statement the following statistics are presented:

The prevalence of dental caries among American grammar-school children was computed by Ottofy from an examination of 14,644 teeth. Caries was present in 27.33 per cent. in males and 32.67 per cent. in females. In an examination of the naval apprentices of the British training-ship "Exmouth" made at about the same period, the average age of the boys being about fourteen years, it was found that 76 per cent. of them had carious teeth. In a more recent examination of the teeth of the school children of Northern Germany, conducted by Dr. Greve of Lubeck, the ages of the children being between twelve and fifteen years, it was found that 94.5 per cent. of them had dental caries in its various stages of development.

The statistics of the United States army dental corps show that dental diseases are as prevalent among the officers and enlisted men of our army as among individuals in civil life of the same social class, while among the troops who have served in tropical and semi-tropical climates these diseases are much more prevalent.

The Surgeon-general's report for 1903 shows that the percentage of dental diseases for troops serving only in the United States was 42.85. For those serving in the Philippine Islands the percentage was 61.12, or 18.27 per cent. higher than for the troops who served only in the United States; while for the troops who served in Cuba and Porto Rico the percentage was 64.02, or 21.17 per cent. higher than for the troops serving in the United States. The increased percentage of dental diseases among the troops who served in Cuba and Porto Rico over those serving in the Philippine Islands is due to the fact that these diseases are generally more prevalent among the native troops of Porto Rico than among the white troops.

The records of my office at the General Hospital, Presidio of San Francisco, show that from October 1, 1901, to July 1, 1904, 4533 cases have been examined and treated for dental and oral diseases, and out of this number only one person has been found who was absolutely free from dental caries; this was a young lieutenant just graduated from West Point military academy.

In an examination conducted by two of my assistants of two regiments of infantry recently returned from the Philippines, it was found that in one regiment 87.62 per cent. and in the other 93.46 per cent. of the men examined were in need of immediate dental treatment.

The statistics for the first-mentioned regiment are as follows:

Total No. enlisted men	738
No. absent for various reasons	27
No. enlisted men examined	711
No. not needing dental treatment	77
No. needing dental treatment	623
Per cent. of regiment needing treatment	87.62

Diseases.

No. of teeth with dental caries	2280
So badly diseased as to require extraction	321
Can be saved by appropriate treatment	1959
Men needing immediate treatment for pulpitis and dento-alveolar abscess	277
Cases of salivary deposits	182
“ “ gingivitis	42
“ “ pyorrhea alveolaris	4
“ needing artificial dentures	14

The statistics for the other regiment are as follows:

Total No. enlisted men in the regiment	780
No. absent for various reasons	15
No. enlisted men examined	765
No. not needing dental treatment	21
No. needing dental treatment	744
Per cent. of regiment needing treatment	93.46

Diseases.

No. of teeth with dental caries	3565
So badly diseased as to require extraction	197
Can be saved by appropriate treatment	3221
Men needing immediate treatment for pulpitis and dento-alveolar abscess	97
Cases of salivary deposits	196
“ “ gingivitis	60
“ “ pyorrhea alveolaris	10
“ needing artificial dentures	18

The Surgeon-general's report above referred to shows that during the calendar year 1902 there were 16,161 officers and enlisted men treated for dental and oral diseases, this number being exactly 20 per cent. of the mean strength of the army for that year, and that 49,483 operations were performed. These operations were largely of an emergency nature and necessary to fit the men to perform their military duties. The average number of operations performed for each person was 3.06.

During the Boer war the British military authorities found it necessary to take cognizance of the fact that their troops in the Transvaal were suffering greatly for the need of the services of skilled dental surgeons. This need was recognized by the government, and one dental surgeon with twelve assistants—undergraduate students from the London Dental Hospital—were sent out to meet this need, inadequately of course, if I may be permitted to judge from my own experience in the United States army.

More recently the British government has regularly appointed eight dental surgeons for duty with the troops of the United Kingdom, but medical officers who are familiar with the needs of the service in this direction have called attention to the fact that this number is entirely inadequate, and that if the desired results are to be obtained a much larger number must be provided.

The German government, through Dr. Richter, a staff surgeon of the German army, has been investigating the question of the need of dental surgeons in the German military service, and he reports that upon the examination of 1000 men of a Saxon regiment he found only 61 who had thoroughly sound teeth, or in other words 93.9 per cent. of the men were in need of dental treatment. Of this number there was an average per capita of nearly two teeth missing and more than four decayed. Of the decayed teeth less than one-half could have been saved by proper treatment, the remainder requiring extraction. In another regiment Dr. Richter found that the number of teeth extracted yearly was about 2300, while 2100 fillings had been placed in decayed teeth and fifty sets of artificial teeth had been supplied. It will be noticed that these statistics are so near to those of the United States army as to be practically the same, thus proving conclusively that dental and oral diseases are about equally prevalent in all civilized nations.

As a result of the investigations of Dr. Richter the general staff of the German army has authorized the issue of instructions to the entire German army in relation to the hygiene of the mouth. Lectures upon the various branches of the subject have been arranged for, attendance upon which is compulsory, and non-commissioned officers are required to see that all prescribed regulations relating to the care of the teeth are rigorously enforced. The medical officers of the German army are hoping that the inquiries of Dr. Richter will lead to the establishment of a corps of dental surgeons. Similar recommendations were made by myself to the Surgeon-general of the United States army more than two years ago.

When the facts are taken into consideration that the officers and enlisted men entering military life are in the flower of their young manhood and that the military medical examiners exclude all but the physically perfect, these statistics in relation to the condition of the teeth of the soldiers is somewhat alarming, and the question that very naturally arises in our minds is, What is to be the outcome of this rapid deterioration of the teeth? Good teeth, or at least serviceable teeth, are exceedingly necessary as a means of maintaining the general health of the individual soldier and consequently of the highest efficiency to an army, particularly when campaigning in the tropics, where the conditions of climate are so enervating and debilitating to the general system, and the necessary changes in the habits of life to meet the new environments are not conducive to the highest physical development and vigor. Resistance to disease under these conditions is greatly lessened, and the individual is consequently predisposed to a certain class of diseases, among which are dental caries, pulpitis, pericementitis, dento-alveolar abscess, pyorrhea alveolaris, necrosis of the jaws, inflammatory and ulcerative conditions of the gums, the oral mucous membrane, the throat and tongue; while various general affections are superinduced as a result of the diseased condition of the teeth and oral cavity or the crippling of the function of mastication by the loss of the teeth, such as indigestion, dyspepsia, gastritis, enteritis, colitis, and numerous nervous affections. The remedy for this alarming condition of dental and oral diseases lies in teaching the soldier the value of oral hygiene, and in furnishing the army with an adequate number of dental surgeons to properly care for the dental diseases of the troops in garrison and in the field. The number of dental surgeons in the United States army and in the British army are entirely inadequate for the ever-present and increasing needs in this direction.

With this somewhat lengthy introduction to my theme I will proceed without further delay to place before you the

PLAN OF ORGANIZATION OF THE UNITED STATES ARMY DENTAL CORPS.

Personnel. The corps is composed at the present time of thirty dental surgeons, divided into a board of examining and supervising dental surgeons, three in number, who were nominated by the Surgeon-general and appointed by the Secretary of War for the purpose of examining candidates applying for appointment in the corps and to supervise the work and the operations of the corps. The officers of the board are a president, who is the senior, and a recorder, who is the junior member of the board. The balance of the corps is made up of twenty-seven dental surgeons who have passed satisfactory professional examinations before this board, and have been appointed by the Secretary of War upon the recommendation of the Surgeon-general for service with the troops.

Official status. The official status of the dental surgeon is a somewhat anomalous one. He is not a commissioned officer nor an enlisted man, but a civil employee. He enters the service under a contract, with the *relative* rank of a first lieutenant, which requires him to perform all the duties of a commissioned officer except to serve on courts-martial or to make contracts for and in the behalf of the government. He is held to the same strict property accountability as a commissioned officer and subject to the same rules and regulations governing the service. But he has no military status, no opportunity for promotion, and is not entitled to commutation of quarters, increased pay for foreign service, longevity pay, or retirement for disability or age.

The contract dental surgeon differs from the contract surgeon in that he does not have an opportunity, as they do, by passing an examination, to enter the medical corps of the regular army. Recent decisions of the Judge Advocate-general have taken away the right of contract surgeons and dental surgeons to issue commands to men assigned to duty under them, consequently it will be necessary in the near future to abolish the contract system as applied to the medical department altogether, and provide a way by which contract dental surgeons may also enter the regular commissioned service.

Pay and allowances. The pay of a contract dental surgeon is $150 per month, which is in lieu of all other allowances except quarters when available. If quarters are not available at his station he must provide them for himself. He has the right, however, to purchase supplies from the Quartermaster's and Subsistence departments at the government rate.

Tenure of office. The contracts made by the War Department through the Surgeon-general or a chief surgeon of a military department are for a term of "not less than three years," and may continue indefinitely thereafter at the will of the contracting parties. Contracts, however, may be annulled at any time by the Surgeon-general or by a department commander for the good of the service, disability, or no further need for services.

Examination of candidates. The examinations consist of—(a) physical condition; (b) written and oral questions upon the studies of the dental college course; (c) practical demonstrations in operative dentistry; (d) practical demonstrations in prosthetic dentistry.

(a) The physical examination is conducted by an army surgeon detailed for this purpose and upon the same general lines as those in vogue for entrance into the other departments of the army. Perfect health and freedom from physical defect are necessary to pass this examination; but defective eyesight which can be corrected by appropriate glasses does not debar the candidate.

(b) Written and oral examinations are conducted upon the following named subjects, and the candidates must attain a general average of seventy-five per cent. upon each of them: Anatomy, physiology, histology, chemistry, physics, metallurgy, dental anatomy, and physiology, dental materia medica and therapeutics, dental pathology and bacteriology, orthodontia, oral surgery, operative dentistry, prosthetic dentistry.

(c) The practical examination in operative dentistry consists of the following: 1. Examination and recording the condition of the mouth and teeth. 2. Preparation of cavities—(a) by hand instruments; (b) by engine instruments. 3. Instrumentation and technique. 4. Preparation and manipulation of filling materials—gold, tin, amalgam, gutta-percha, oxyphosphate cement. 5. Insertion and finishing of fillings. 6. Treatment and filling of root-canals and preparation of root for pivot crown. 7. Manipulative technique in removal of calcareous deposits. 8. Application of rubber dam, metallic separators, matrices, etc. 9. Diagnosis, prognosis, and treatment of oral diseases. 10. Care and sterilization of instruments and hands.

(d) The practical examination in prosthetic dentistry comprises—1. Impressions, casts, bite, and articulation (occlusion). 2. Construction of denture in vulcanite. 3. Construction of dies and counter-dies from impression to completion. 4. Construction of swaged plate, with metal and rubber attachment. 5. Construction of interdental splints. 6. Construction of Richmond crown.

Upon all clinical or practical demonstrations the candidate must attain a general average of eighty-five per cent. The reason for this higher requirement in the practical branches is made evident by the statement that practical men are needed in the service, not theorists. But it may also be stated that practical ability alone would be of little value in military dental practice. The dentist to be successful in this new field of practice must be thoroughly informed upon all those subjects and theories which form the foundation of modern dental surgery. He will need to be self-reliant and capable of conducting any case that may come under his special care, no matter how serious it may be, for he will many times be so located that he cannot obtain the advice of a consultant in his specialty; while, on the other hand, he may be, and that frequently, called in by the post surgeon as a consultant in cases which present oral or dental lesions; or which by reason of certain symptoms the surgeon is led to believe may be dependent upon some obscure dental or oral malady and upon which he desires an expert opinion to assist him in an intelligent treatment of the case, or recommending the discharge of the patient for physical disability incident to the oral or dental condition.

ARMY REGULATIONS GOVERNING THE PROFESSIONAL DUTIES OF THE DENTAL CORPS.

The following regulations, having received the approval of the Honorable the Secretary of War, become, with the general regulations bearing upon officers of the army, the law governing contract dental surgeons:

Candidates for appointment as dental surgeons must be not less than twenty-four nor more than forty years of age. They must be graduates of standard medical or dental colleges, trained in the several branches of dentistry, of good moral and professional character, and prior to appointment will be required to pass a satisfactory professional examination before a board of dental surgeons convened for that purpose by the Secretary of War.

Contracts with dental surgeons will be made for three years, but may be annulled at any time by the commanding general of a military department, after official investigation, for conduct to the prejudice of good order and military discipline, or by the Surgeon-general when in his opinion a termination of the contract would be in the interests of the service.

Dental surgeons are attached to the medical department and will be assigned to duty in accordance with the recommendations of the Surgeon-general of the army or the chief surgeon of a military department.

A dental surgeon when assigned to a station will apply to the post commander for a suitable operating room. If no other room be available the surgeon of the post may assign him a room in the hospital.

Each dental surgeon will ordinarily be allowed one enlisted man as an assistant, who will be detailed from the sergeants or privates of the Hospital Corps, and whose duty it will be to assist the dentist in his operations, in caring for the instruments and other public property, in keeping the records, and in the performance of such other official work pertaining to the position as he may be directed by the proper authority to do. When a member of the Hospital Corps is detailed as a dentist's assistant he will receive commutation of rations at the rate of one dollar daily, and he will be provided with a suitable room as quarters by the Quartermaster's department, except while on duty at a post, when he will be attached to the hospital corps or other organization for rations and quarters. Necessary dental instruments and supplies will be purchased by medical supply officers under instructions from the Surgeon-general and in accordance with a supply table approved by the Secretary of War.

Dental surgeons will be held strictly

accountable for all instruments and supplies issued to them, and will be governed by army regulations and orders now in force, or hereafter to be issued, with reference to accountability for government property.

In accordance with the act of Congress authorizing their employment, dental surgeons will "serve the officers and enlisted men of the regular and volunteer army." The families of officers and civilian employees attached to the army are not entitled to their services. In this connection contract surgeons are to be regarded as commissioned officers.

Dental surgeons will operate between the hours of 9 A.M. and 4 P.M. only upon those officers and enlisted men who are entitled to their services. They may operate upon others not entitled to free services before and after those hours when their services are not required by those entitled to them, but material issued to them by the government will only be used in operations upon officers and enlisted men of the army.

Dental surgeons of the army will not perform any operation upon officers or enlisted men or prescribe medicines for them other than those necessary for the treatment of the teeth and gums. This prohibition does not apply to cases of emergency where no medical officer is within reach, and where a dental surgeon is able to render the necessary surgical assistance to meet the immediate emergency.

Emergency work, whether for officers or for enlisted men, should always have precedence. Plate work or restoration of teeth by any method will only be done for those who have lost teeth in the service and in the line of duty. For plate work or filling teeth only the cheaper materials will be supplied, but gold may be used, if the operating dentist sees fit to use it, at the expense of the individual operated upon.

Enlisted men requiring the services of the dental surgeon will, at an hour prescribed by the commanding officer, be conducted to the designated place under a non-commissioned officer, who will take with him and hand to the dentist a list of those reporting for treatment. This list will be entered in a day-book ruled in columns for surname, given name, rank, company, regiment, etc., all headings to be the same as those borne on his monthly report.

All cases requiring treatment involving future appointment will be so noted, and the others will be marked according to the circumstances, as "treatment unnecessary," "further treatment unnecessary," "should be sent to the surgeon," etc. When future treatment is necessary the dentist will forward a card as follows:

......................, 19..

THE ADJUTANT:

....

Sir,—I have the honor to request that....
............be directed to report to me from
......M. to......M. on ....instant
for treatment.

Very respectfully,
....................,
Dental Surgeon.

Dental surgeons will submit a monthly report (on prescribed blanks) of all official work done by them, giving all required data in every case in which professional services were rendered. This report will be an exact copy of the register kept for the period. One copy will be sent on the last day of the month to the Surgeon-general, through the chief surgeon of the department in which the dental surgeon is serving.

Dental surgeons will also prepare a tabular statement for each month on blanks termed "Numerical report of dental operations," showing the number of persons treated, the number of cases of each disease and injury, the operations performed and the restorations by the use of fillings of each kind and by the use of bridges, crowns, and appliances. On the back of this sheet will be shown, by races, the individual teeth affected by caries. This report will be forwarded each month with the dental surgeon's report of operations.

The supply table. This table is too long to present in this place, but it may be stated that it includes a portable dental chair and a dental engine, packed in separate cases; burs, mandrels, stones, disks, etc.; excavators, chisels, scales, plastic-pluggers, gold-pluggers, rubber-dam clamps, clamp forceps, dam punch, extracting forceps, elevators, steam sterilizer, hand cuspidor, etc., in fact, all of the instruments and adjuncts that are really necessary to perform any operation upon the teeth, except for crowns, bridges, and artificial dentures. Each outfit contains medicines and supplies of filling material sufficient for three months' service. The smaller instruments and the supplies are packed in two strong cases, arranged with trays and receptacles to hold the instruments and supplies in place. The whole outfit when cased and crated weighs about 450 lbs. To protect the cases from rain and dampness they are inclosed in canvas covers. The general hospitals, and such other posts as may be designated by the Surgeon-general, are furnished with an additional outfit, consisting of a regular office operating chair, Allan bracket, cuspidor, instrument case, extra extracting forceps, and a full laboratory outfit for constructing vulcanite plates, swaged metal plates, interdental splints, crowns, and bridgework.

Nosological table and system of keeping records. The ordinary system of keeping records in civil practice by means of charts could not be employed in military practice, for the reason that it would occupy too much space. As a substitute for this the following system has been devised and has received the approval of the Surgeon-general.

DISEASES AND INJURIES OF THE MOUTH.

Abrasions (mechanical).
Abscess of the jaws (associated with impacted teeth).
Calcification of the pulp.
Caries.
Cysts of the jaws (associated with devitalized teeth).
Dento-alveolar abscess.
Erosion (chemical).
Fractures of the teeth.
Hemorrhage (following extraction).
Hypertrophy of the pulp.
Hypertrophy of the gums.
Hypercementosis.
Necrosis of the teeth.
Pericementitis, acute.
Pericementitis, chronic.
Pulpitis, acute.
Pulpitis, chronic.
Pyorrhea alveolaris.
Resorption of the alveolar process.
Salivary deposits.

NOTE.—The duties of the dental surgeon will ordinarily be confined to the treatment of such cases as are directly associated with the teeth and gums; but occasions may arise when his services would be required as a specialist in the treatment of diseases and injuries of the mouth and jaws, such as cysts of the salivary ducts, empyema of the maxillary sinus, fractures of the jaws, gingivitis, necrosis of the jaws, facial neuralgia, stomatitis, and tumors of the gums, jaws, etc.

CLASSIFICATION OF THE TEETH.

1. Superior central incisors.
2. Superior lateral incisors.
3. Superior cuspids.
4. Superior first bicuspids.
5. Superior second bicuspids.
6. Superior first molars.
7. Superior second molars.
8. Superior third molars.

9. Inferior central incisors.
10. Inferior lateral incisors.
11. Inferior cuspids.
12. Inferior first bicuspids.
13. Inferior second bicuspids.
14. Inferior first molars.
15. Inferior second molars.
16. Inferior third molars.

In designating the teeth, and in recording all operations upon them, the dental surgeon will indicate the tooth by the following plan, using the letters R. and L. to designate the right and left sides, and the figures 1, 2, 3, etc., to designate the tooth. Examples: R. I. Right superior central incisor; L. 14, Left inferior first molar.

CLASSIFICATION OF CAVITIES.

Simple Cavities on Exposed Surfaces.

Incisors and cuspids.	Bicuspids and molars.
A. Labial.	D. Morsal.
B. Lingual.	E. Buccal.
C. Morsal.	F. Lingual.

Simple Approximate Cavities.

Incisors and cuspids.	Bicuspids and molars.
G. Mesial.	I. Mesial.
H. Distal.	J. Distal.

Compound Cavities.

Incisors and cuspids.	Bicuspids and molars.
K. Mesio-labial.	R. Mesio-morsal.
L. Disto-labial.	S. Disto-morsal.
M. Mesio-lingual.	T. Morso-buccal.
N. Disto-lingual.	U. Morso-lingual.
O. Mesio-morsal.	V. Mesio-disto-morsal.
P. Disto-morsal.	W. Bucco-linguo-morsal.
Q. Mesio-disto-morsal.	

In recording all operations of filling the teeth, the cavity will be described by the dental surgeon according to the preceding classification, using the letters A, B, C, etc., to designate its location.

Example: A, Simple cavity in labial surface of an incisor or cuspid tooth. I, Simple cavity in mesial surface of a bicuspid or a molar. V, Compound cavity in mesial, distal, and morsal surfaces of a bicuspid or a molar.

CLASSIFICATION OF FILLING MATERIALS.

Tin.
Amalgam.
Oxyphosphate.
Gutta-percha.

The kind of filling material employed will be indicated by using the first letter of the word designating that material.

Example: R. 5 V. A. Tooth, right superior second bicuspid; cavity, mesio-disto-morsal surfaces. Filling material, amalgam. If a combination filling is employed it will be designated by the first letters of the words designating the materials used. Example: L. 7 S. G.-O. Tooth, left superior second molar; cavity, disto-morsal surfaces; filling material, gutta-percha and oxyphosphate cement.

Exception: The only filling materials furnished for the use of the dental surgeons by the medical department are those enumerated above. Gold, however, may be provided by the dental surgeon and inserted for those officers and enlisted men who are willing to reimburse him for its cost. The minimum fee to be one dollar, and the maximum two dollars, for such filling.

In recording operations made with gold the full word should be written out.

Other operations upon the teeth will be designated by a combination of letters, as follows:

Abscess lanced ..A-L.
Calculus removed.C-R.
Pulp devitalized..P-D.
Pulp extirpated..P-E.
Root-canal filled..R-F.
Tooth extracted..T-E.
Tooth treated....T-T.

One hundred of these record sheets are bound in a book, and form the "Register of dental operations." Each month the dental surgeon is required to send to the Surgeon-general an exact transcript of the register of the operations performed during the month, upon blank sheets known as the "Monthly record of dental operations." These reports are placed on file for future reference. The register when filled is transmitted to the Surgeon-general and also placed on file.

These records form an important means of identification in case of death or desertion, while to the Pension Office they will prove of value in passing upon those applications for pension which are based upon the loss of teeth while in the service of the United States army.

They will also prove to be of immense

value from the scientific standpoint, in efforts to settle the questions of the relative prevalence and spread of dental caries among men who have been selected for military service because of their perfect physical condition, as compared with men in civil life; of the relative increase in this disease resulting from physical and nervous strain of severe campaigns and of residence in tropical climates; of the causes and prevalence of pyorrhea alveolaris, gingivitis, stomatitis, and kindred oral affections.

It will be noticed by the regulations governing the army dental surgeons and the rules laid down by the Surgeon-general, that the only filling materials which are furnished by the government are tin and the plastics; but the dentist is not prohibited from using gold, if the officer or the enlisted man be willing to reimburse him for the material used. (This material he must carry with him at his own risk.) In fact, he is encouraged to use gold by being furnished with instruments and appliances with which to perform this class of operations. He is furthermore furnished with a private or a sergeant of the hospital corps, whom he is expected to train as an assistant. With such intelligent assistance there is no reason why as good gold fillings may not be inserted by the military dental surgeon as by the dentist in civil practice.

The character of the service which can be rendered in the field must of necessity be that of meeting emergencies. Relief from suffering is the first object of the treatment, and the introduction of temporary fillings to protect the teeth from further decay until a more favorable opportunity can be secured for inserting a permanent filling.

The dental surgeon will, however, as a rule, be located at posts and stations of a more or less permanent character, where he can conduct his practice with as much care and thoroughness as is possible with the civil dental surgeon.

Each dental outfit is provided with a quantity of modeling composition and impression-trays, so that fractures of the maxilla can be treated temporarily by interdental supports made from the modeling composition while the patient is being transferred to the general hospital, where facilities will be found for constructing any form of interdental splint or other mechanical apparatus that might be indicated.

The army dental surgeon is expected to confine his professional services to the treatment of the diseases of the teeth and their associated parts, but the regulations provide that in cases of emergency, when no surgeon is present, he may, if competent, render any assistance that the case may demand.

The dental surgeons located at general hospitals and large posts are furnished with as good and as complete an outfit for a general dental practice as is found in the offices of the best civil practitioners. At such stations the dental surgeons have frequent opportunities for the treatment of cases in orthodontia for the children of the officers of the station, or inserting bridges, crowns, and artificial dentures for the officers and enlisted men, and for their families; while the general hospitals furnish a certain number of cases of fractured maxilla that need to be treated by the construction and insertion of some one of the various forms of interdental splints.

From the foregoing it will be seen that the War Department, through the recommendations of the Surgeon-general, has provided for the care and treatment of the dental and oral diseases of the army in as thorough and as scientific a manner as is possible under the exigencies of military life and movements. Experience, however, may make it necessary to institute certain changes and modifications in the present system of service, and when such action is proved to be essential to the welfare of the army and an increased efficiency of the corps there is no doubt that the proper authorities will immediately institute such changes and modifications.

Discussion.

Dr. C. S. STOCKTON, Newark, N. J. I take the ground that if a man is sick in his teeth, he is equally as sick as if afflicted in any other part of the body, and should therefore receive proper treatment. The time has come when these brave boys who go out to defend our homes and our honor should be prepared to do so, and they should have the same treatment and the same care and consideration, if not more, than that of any other class for whom we care, for no soldier can do his duty with the toothache. It is appalling almost, Mr. Chairman, to think that only twenty per cent. receive the attention they should receive. Every man in our army—officer or private—ought to receive the treatment that he needs, and it should be one hundred per cent. We are coming to the period, Mr. Chairman, when we shall demand and when he will receive this treatment. I admit perhaps that we have not been in a position to take this stand. It has been stated that we are only dentists. We mean that in the future, when you say we are only dentists, it shall mean everything that is requisite to treat the human body. We have taken the position here since the board of examiners met, that the young men coming into the profession shall have an education equivalent to that required to enter the freshman class of any university in this country. And the faculties of the dental institutions of this country will be compelled to make that requirement, and the examining boards of this country will stand behind these faculties, and if they do not come up to that standard their young men will not receive a license to practice. And that, Mr. Chairman, will place dentistry in the position that it should occupy—on an equal basis with medicine. The dental surgeon in the army shall have the same treatment and the same consideration, the same title and the same honor, that is accorded to the medical man. It is only right, and we shall gain it. I claim also that the time will soon come when the brave boys in our navy will have the same treatment as those in the army, and when the time comes to ask for this I hope that you gentlemen scattered throughout this broad land of ours will make your influence felt in Washington, so that when the bill comes up for the consideration of the grade to be given to dentists in the army and for the organization of a dental service in the navy, your representatives in Congress will be fully informed. (Applause.)

Dr. TRUMAN W. BROPHY, Chicago. Mr. President, this is a world's congress of dentists, and we are dealing with subjects that pertain to the dental surgeons of the armies and navies of the world, and I take great pleasure in saying that while studying this question in other countries, I have found that it is essential that every physician and surgeon who enters the English army at the present time must have taken a course in the diseases of the teeth. Every surgeon that enters the Spanish army must have a course in dental pathology that he may recognize and may be qualified to relieve distress in the case of each soldier and sailor in the service of his country. I hope we will look upon this question from the broad point of view of the world, so that this discussion may bear upon soldiers and sailors wherever they are found representing their respective countries. Resolutions have been offered in the past requesting, and expressing the opinion, that dental surgeons should be appointed in all countries, and I sincerely hope that this body will take up the matter and pass resolutions as an expression of opinion, that dental surgeons should be appointed wherever the soldier and sailor may be found. (Applause.)

Dr. **Wms. Donnally**, Washington, D. C. Mr. President, I have listened with attention and interest to the reading of the paper, and have heard with surprise the discussion. It is not my purpose to discuss the paper, which is so full and complete and covers the ground so thoroughly that no additional word is necessary, yet it does seem to me, Mr. President, that it may be further discussed. Our distinguished friend from New Jersey has prepared you to expect a bill to be presented to Congress. He has proposed that you give your earnest support to the bill, but I would like to say that the National Dental Association has had for six years a committee in charge of this subject, and it was through the efforts of this committee that the contract corps of army dental surgeons was established, and through the efforts of this committee that the bills which have been for several years pending in Congress have been considered by the War Department and by the Navy Department, and by those committees of Congress which control the legislation for the army and navy of the United States. These bills provide commissioned rank for both army and navy dental surgeons and have been published in the dental journals—a fact which Dr. Stockton seems to have overlooked. They have received the most careful consideration and hearty support of many members of Congress. The naval and military committees of the two houses of Congress have for three years recognized the justness of the profession's claim for the status which is implied by commissioned rank. The military committee of the house, by a vote of eight to five, declared for commissioned rank. Secretary Moody on the 2d day of March, in accordance with a letter written on the 23d of February, 1904, to the authorities of Harvard, recommended to Congress the commissioned rank for dental officers of the navy. There is no authorized dental service in the navy in the proper sense, yet there are a very few dentists now serving in the navy as yeomen or hospital stewards, and there is one civilian dentist employed by law at the naval academy. The army had some dental service even before the dental corps was organized, but they now have an efficient service, though inadequate in numbers and lacking rank.

As members of the committee of the National Dental Association, Dr. Finley and I are authorized to say to this Fourth International Dental Congress that an agreement has been reached by which the War and Navy departments concede the committee's contention for commissioned rank for military and naval dental surgeons, and, if the arrangement is not defeated by antagonistic influences, it is confidently expected that this committee will, in co-operation with those departments, secure reasonably satisfactory legislation by Congress at its next session.

I may say further that this committee has had the support of the profession and the co-operation of a large proportion of our men of influence and of the college authorities. The most effective aid in overcoming the navy's opposition was that alluded to as coming from Harvard University, and there seems now, Mr. President, nothing needed in the line suggested by Dr. Stockton. Indeed, sir, the battle has been persistently waged for years, and now that an agreement has been reached on the essential claim of the profession—*commissioned rank*—there can be no doubt that the military and naval committees of Congress, always favorable to our contention, will accord us at least all that the War and Navy departments concede. (Applause.)

Dr. Louis Ottofy, Manila, P. I. Mr. President, I listened with a great deal of interest to the very valuable contribution of Dr. Marshall. I have had perhaps as much experience in this line as any man here. I have practiced for perhaps three thousand soldiers, members of the marine corps, and five hundred officers, from major down to second lieutenant. It has been my privilege to personally know the officers and the men, and while I agree with much that the paper contains, I believe that we are discussing the whole question on a wrong basis. I may say here for the information of those who do not know what an army officer is. that you may live in the same neighborhood and become fairly well acquainted with him, yet he will not mingle socially with you; and it is absolutely necessary that it should be so for the greatest good. The purpose of the army officer is to fight in war and to prepare for fight in peace. These are the only two things in the head of the best officer there is. He studies engineering, science, tactics, and everything with no other purpose than these two things. The main object of the officer is to cut off from his train everything that is superfluous. And they would cut off the commissary train, but the men have to eat—but that they carry in as concentrated a form as possible. In the army they don't want the medical corps, but they have to have it. They fight continually to cut off everything that is unnecessary, and gentlemen, there is as much need for a chiropodist in the army as there is for a dentist. Now, the corps has done good work, and the gentlemen I have met are nearly all of them of high character, and represent properly as they should the profession, but I tell you, gentlemen, it is very important for them to make a big record! I have seen many of these men that go around as dentists put in ten small fillings in molars and call it ten operations. He does not put in gold fillings because the men have not the money to pay him, and those who have he works for after hours. Their salaries are small and the men have to have money, so they work outside for it.

Dr. O. M. Sorber, San Antonio, Texas. Dr. Ottofy makes some very serious charges with regard to the work done in the army. I don't know very much about other dental surgeons, or how they do their work, but he did not make any exceptions, and I believe I am an exception to the charges made, however much it may be true of others. I don't believe it is true of all others. I have seen some work done by army dental surgeons that I would be glad to submit to the gentleman who has just spoken as samples of the work done. Each dental surgeon in the army has to keep a schedule and register of all the dental operations performed, and the doctor can see for himself by referring to the schedule all the operations performed by the dental surgeon. I think if he will examine these schedules he will find an unusually large number of large operations, compound fillings, root-canal fillings, etc. Unfortunately not very much crown and bridge work is done. The men have not time to do it, as each one has about four times as much work as he is physically able to do. I might say that while I was situated at Little Rock, in two days less than two months I did 789 operations, and in that number there were over a dozen gold fillings, at least three-fourths were amalgam fillings, and an unusually large proportion of large cavities. I think if any man does in two months that number of fillings he has done about all that can be expected.

Dr. A. W. **Harlan**, New York, N. Y. The instructive and interesting paper read by Dr. Marshall, the head of the United States army dental corps, appeals to us in that it refers to the individual work done by the men in the corps that is not done by a single surgeon outside of the army. In this way it is an appeal for the permanent establishment of the corps with rank and pay sufficient so that when the man has done the work he will be entitled to increased compensation and be able to retire as does any other army officer. It may be true, as Dr. Ottofy says, that many men only strive to make a big record, but it is also true that when men go to these tropical climates they cannot physically perform the work done north of Mason and Dixon's line and even farther south than that. Another thing that appealed to me is the fact that this corps is irregularly organized, so that the services of the men can be dispensed with at any moment, even by a department commander; they have no permanent standing, and that is the particular thing to be noted from this most excellent and interesting paper.

Dr. M. F. **Finley**, Washington, D. C. *Mr. Chairman and gentlemen:* I wish to state that in my mind this is a very valuable contribution in support of the work that has been done by the National Dental Association. It bears out the contention first made by that association's committee to Congress in behalf of the establishment of a corps for the care of the teeth of the soldiers of the United States army. The data presented is gratifyingly supplemental and confirmatory of that which that committee offered Congress as evidence of the army's need for such a corps, and I am glad to have it presented here, and in the Surgeon-general's official report, because it so well supports the claims made by the profession's representatives.

I wish to say in answer to one statement made by Dr. Stockton about the comparative indifference of the government to the soldiers, that I have seen a copy of the regulations as drawn up by the medical corps of the army for the information and guidance of those concerned, in the division of the Philippines, and these regulations give the authority to court-martial the soldier who refuses to submit to an operation deemed necessary by the dental surgeon, in order to preserve health and fitness for military duty.

The contention of the National Dental Association through its committee has been for commissioned rank from the start, but the opposition of the War and Navy departments has stood in our way.

Happily this obstacle has been cleared away in both departments during the past winter, and with this concession to our claim for commissioned rank there seems to be every reason to expect, as stated by Dr. Donnally, satisfactory legislation by Congress at its next session.

Dr. J. Y. CRAWFORD, Nashville, Tenn. Mr. President, being one of the duly accredited representatives of our government, I feel it my duty to state that this contribution is a very valuable one, though much of the paper I should have left out as unnecessary.

One suggestion made in the paper struck me very forcibly, and that was that the United States Government has stipulated that when a man is writing a prescription for the treatment of dental caries, certain materials should not be supplied. Mr. President, the best should be supplied by the nations of the world for the treatment of the organs of mastication of their soldiers. No compromise should be made as to the quality of the therapeutic agent to be used, and I have the temerity to state that I think the nations of the earth should not compromise when it comes to making provision for the eradication of dental disease. If one agent be more efficacious and efficient, that one should be employed. The nation should not handicap a man when he undertakes to write a prescription for any kind of disease. Now I make this declaration in support of the teaching of the paper, to encourage the idea of meeting, in a general way and in every way, the adaptation of the dental surgeon to the wants and needs of the armies and navies of the world. (Applause.)

Dr. C. L. HUNGERFORD, Kansas City, Mo. I did not have the pleasure of listening to the paper, but I heard enough of the discussion to know its trend and that it is relative to giving the soldiers of our army and navy the best work commensurate with our opportunities.

The therapeutic agents to be employed or the materials to be used on the American soldier must be confined to those which the dentist can use under the adverse conditions of army life. No dentist with the number of soldiers he must necessarily have under his care could use what is ordinarily supposed to be the best filling material. He must use those things which will give the soldier the greatest comfort for the few years that he is in the army.

Dr. Ottofy was correct when he stated that the chiropodist gave the soldier the greatest amount of comfort. It does not please you, I know, but it is true, and it is the truth that generally hurts. We cannot put operations of gold or porcelain in the mouths of the men who are to remain in the army for only a few years, nor can we put bridges in the mouths of these men as they should be put, therefore common sense teaches that we must seek and employ those materials that will give the greatest amount of good to the greatest number of soldiers. I think the government is right in excluding gold fillings, crowns, and bridges from the operations performed by the army dentist. The object of the government is to render to soldiers the best service in getting their teeth comfortable so that they can go into battle. It should not be expected to give a permanent operation to a man who is not in need of immediate attention, to the exclusion of others with the toothache.

Dr. CHAS. GODON, Paris. Mr. President, I would like to say a few things on this subject. This is not a national question, but an international one, and I must congratulate Dr. Marshall and the

Committee of Organization for bringing it before the congress in general session, and I must congratulate your American government for this organization in the army, because in our country we cannot yet obtain such conditions. We have only begun to organize these institutions in France, and they are not complete to the extent that they are here. In the army dental service, as in other public dental services, the preference should be given to complete instead of emergency dentistry. I congratulate your government because I learn that in your army and navy your dental surgeons can insert fillings and do all other dental work when needed.

I have presented to the resolutions committee a resolution recommending for the poor complete dentistry instead of emergency dentistry, and I think this principle likewise applicable to the armies and navies of the world.

Dr. OTTO HOLLINGER, Chicago. It was my good fortune to serve the United States navy in the Spanish-American war as an ordinary sailor, and I agree with Dr. Marshall in the contention for dentists in the navy and in the army. It is true, as Dr. Ottofy stated, that the ordinary private both in the army and navy is not perhaps the patient that the general practitioner of dentistry who has practiced for twenty-five or thirty years would care to spend his time upon. But, gentlemen, these same boys fighting behind the guns are taking your place and making it possible for you to practice in your own country. I have been among those boys, and I can very readily sympathize with them. When we were on board the flagship Lancaster at Key West, preparatory to going to Cuba, one of these boys, a marine, came to me with an aching molar. Unfortunately I had gone away so suddenly that I did not have any medicine or instruments with me, and I sent him to a surgeon, who found a third molar aching very badly. The surgeon thought that by extracting the third molar he would relieve the toothache, but he broke the tooth off, and thinking that the tooth was locked with the second molar, he extracted the second molar also, but the toothache was not stopped and he then extracted the first molar which was also decayed. There were three teeth lost, and the poor fellow was sent out to service, but he came back in about two weeks in a very bad condition and was sent to the hospital, placed under a general anesthetic, and the roots were taken out.

In the time of service one does not perhaps need crown and bridge work, but these men should have attention given to aching teeth, and then when they come into port they should receive the best that the science can give, because these men are giving their best to the government; the crown and bridge should be then put on with the best of gold and the best of care. Should the navy dentist become so proficient as to be able to command a better *clientèle,* he should then give way to the younger men. An experience of that kind is valuable to any man. Dr. Marshall's suggestions and statements will perhaps in the course of time be greatly modified, but as for belittling these men who are giving their lives for us for from thirteen to nineteen dollars per month, I do not think that the Fourth International Dental Congress should go on record as countenancing anything of the kind. (Applause.)

Dr. C. M. WORK, Ottumwa, Ia. I am very glad to have had the opportunity of hearing Dr. Marshall's paper, and I want to congratulate him on the able manner in which he handled his subject. I have been very much interested in the army dental service for a number of years. I am one of the men whom Dr. Donnally spoke of as having practiced before there was any organized dental corps. I can see lots of flaws in the way the corps is organized which of course to my mind seem faulty, but whether I could do better would remain to be seen. I know in the present condition, when a soldier meets a dental surgeon he would not respect him the same as if he were a commissioned rank officer. I was a private myself, and practiced for the soldiers and the surrounding people. I hope to see the dental corps of the United States army supplied with men of ability and in sufficient number to carry out any kind of service the private soldier or the officer in the regular army may need, not restricting them to certain materials for their use, or certain medicines, as this is certainly poor treatment for men who serve in the army, especially as some of them serve for twenty-five or thirty years.

Dr. J. S. MARSHALL (closing the discussion). *Mr. President, ladies and gentlemen:* I thank you most sincerely for the cordial reception you have given my paper. I have tried to put before you a few scientific facts in relation to the prevalence of dental diseases among all civilized nations; but the main object of the paper has been to place before you, and particularly the delegates from foreign countries, the need of dental surgeons in the armies of the world, and also to give you an intelligent idea of the organization of the United States army dental corps as perfected by the military authorities of our government—hoping that, out of this, new interest might be stimulated in foreign countries with a view of organizing similar dental corps for the armies of the civilized world.

I was grieved to hear, however, the statement made by Dr. Ottofy. I consider Dr. Ottofy my friend and have considered him a friend of the dental corps, and therefore I do not think that he would do us a wrong knowingly. I think that he has been misinformed in relation to the character of the service rendered by the dental corps of the army; I am positive that some of the charges he makes are not correct. It has been my privilege to go over the records of the professional work of the corps from its organization up to the present time, and I have been commissioned by the Surgeon-general to make up the reports which he has incorporated in his report to the Secretary of War. I know positively that the only effort that has been made to make a "big record" on the part of the dental surgeons in the Philippines has been to render the greatest amount of service possible, and not only service such as he speaks of, but a service aimed to relieve suffering and conserve the teeth. If you were to go through the records of the corps at Washington it would become evident that the greatest amount of service rendered was of an emergency character, such as the treatment of pulpitis, dento-alveolar abscess, gingivitis, stomatitis, pyorrhea alveolaris, and large contour fillings. That is the kind of service which has been rendered, and I am proud, gentlemen, that the corps has made such a fine record. Our dental surgeons frequently work far beyond the hours prescribed by the army regulations in order to take care of these emergency cases. I know of many instances where they have worked from eight o'clock in the morning until five or six o'clock at night—and army regulations do not require their services except from nine o'clock in the morning until four in the afternoon. Many instances can be mentioned of this kind, and also where they only take fifteen or twenty minutes for lunch in order to meet the pressing need for their services. That is the kind of service that is being rendered by the United States army dental corps.

Criticism has been raised against the War Department with regard to the kind of filling materials furnished. Now, when this corps was organized I had a personal interview with the Surgeon-general and asked him what he expected the corps to do. He said, "We expect you to relieve men from suffering and fit them for duty." I asked him what kind of materials he expected us to use; if gold fillings would be expected or required. He said, "Dr. Marshall, let me ask you a question. Do you suppose that you will find many men in the United States army who, if gold were used in their teeth and their teeth put in good condition, but what it would cost the government fifty or more dollars per man to do that work?" I answered him that I did not think he would find many cases that would cost less than that to put their mouths in good condition. And my experience in the service corroborates the view then expressed. The Surgeon-general then said, "If it is true that it would cost that much, or even considerably less, the government would not sanction this kind of service, for the reason that the greater number of enlisted men enter the service for three years and the majority of them go out when their enlistment expires." He said it would be our duty to save the teeth by the means placed in our hands; to so treat the men as to render them fit to perform military duty, and when we had done that we would have done all that was expected of us. We, however, went further than that, and did as much gold work for the officers (who enter the service for life) as we could prevail upon them to have done. With the men who are enlisted for only three years we do the best we can to save the teeth with the materials furnished us by the government. We try to do the greatest good to the greatest number. The supervising board have instructed the dental surgeons that their first duty was to save teeth, to treat as many as possible, and relieve from suffering as many as possible. And, gentlemen, these instructions have been faithfully carried out. We have done our very best, every man of us; of that I am sure, and more than this could not reasonably be asked of us.

There were some other questions that I wanted to answer, but the time is short, and I think I have said sufficient. (Applause.)

Dr. J. Y. CRAWFORD. I would like to ask, Mr. President, unanimous consent of this body to refer Dr. Godon's resolution [see page 54] to Dr. Donnally's committee.

The PRESIDENT. If there is no objection the resolution will take that course.

There being no further business before the house, the President declared the meeting adjourned until 10 o'clock Friday morning.

THIRD GENERAL SESSION—Friday, September 2d.

The third general session of the Fourth International Dental Congress was called to order at 10.45 A.M. by Dr. H. J. Burkhart, president.

The PRESIDENT. Is the Committee on Resolutions ready to report?

Dr. CRAWFORD. Mr. President, your Committee on Resolutions would ask unanimous consent that Dr. Jenkins be permitted to present a resolution, and, immediately following that, your committee would ask unanimous consent that Dr. Williams Donnally be permitted to make a report upon a subject which was referred to his committee by special order; your chairman will then be ready to report on the proceedings of the Committee on Resolutions.

Dr. JENKINS read the resolution in regard to Consul-general Worman, Munich. [See page 59.]

The PRESIDENT. This resolution under the rules will go to the Committee on Resolutions.

Dr. DONNALLY then read a report of the Committee on Promotion of Appointment of Dental Surgeons in the Armies and Navies of the World, and the resolution which here follows:

RESOLVED, by the Fourth International Dental Congress, a body organized under the auspices of the directory of congresses, Universal Exposition, St. Louis, 1904, that it is the sense of the 1600 delegates representing England, France, Germany, Austria, Russia, Spain, Italy, Japan, China, the United States, and other countries, that it is the duty of every government, for humane, hygienic, and economic reasons to provide, in connection with its military medical service, an educated and adequate dental service to aid in conserving the health, comfort, efficiency, and martial spirit of its country's defenders; and be it further

RESOLVED, That the President of this the Fourth International Dental Congress is hereby authorized to appoint an international committee, consisting of one representative from each country, whose object it shall be to secure governmental provision for an educated and efficient dental service to military and naval men wherever practicable; and that this committee, when organized, shall operate under the supervision of the International Dental Federation.

Report of the Committee on Resolutions.

Dr. CRAWFORD then read the following report of the Committee on Resolutions:

Mr. President, and Members of the Fourth International Dental Congress:

Your Committee on Resolutions begs to report the following:

At its first meeting Dr. Chas. Godon, president of the International Dental Federation, presented a report from the International Dental Federation embodying the rules, regulations, and by-laws of the International Dental Federation. Your committee would recommend the adoption of the report on the rules and regulations recommended for the government of future international dental congresses, and that they be concurred in.

With reference to the future work of the F. D. I. the following resolution was adopted:

"RESOLVED, That this committee, in view of the splendid work accomplished by the F. D. I. in harmonizing national ideas upon questions of legislation, education, and public dental service, affirms its belief in the utility of a second period of its activity, and recommends that the Fédération Dentaire Internationale be continued for a second period until the opening of the Fifth International Dental Congress under the following rules and regulations, to wit": [For Rules and Regulations of the F. D. I., see page 24.]

We also recommend the adoption of the following:

"RESOLVED, That nominations for the offices of president, secretary-general, and treasurer of international dental congresses shall be made by the Committee of Organization, and that election shall be made by the members of the congress at its opening session."

In pursuance of the regulation in the new code of rules of the International Dental Federation providing for an Executive Council of fifty members, we recommend the election of the following to membership in the council. These recommendations are made upon the recommendation of the Council of the F. D. I.:

United States (5): B. Holly Smith, William Carr, Edward C. Kirk, A. W. Harlan, and Burton Lee Thorpe.
Great Britain (5): (To be appointed by the B. D. A.)*
Russia (3): Drs. Klingelhoefer, Ayarapaa, and Totwen.
Germany (5): Drs. Miller, Hesse, Schaeffer-Stuckert, Hielscher, and Walkhoff.
Austro-Hungary (3): Drs. Weiser, Zsigmondy, and Arkövy.
Spain (2): Drs. Aguilar and Portuondo.
France (5): Drs. Godon, Sauvez, Martinier, Roy, and Pont.
Italy (2): Drs. Guerini and A. Chiavaro.
Switzerland (2): Drs. Bryan and Guye.
Holland (1): Dr. Grevers.
Belgium (1): Dr. Rosenthal.
Portugal (1): Dr. Cortereal.
Sweden (1): Dr. Förberg.
Norway (1): Dr. Smith-Housken.
Denmark (1): Dr. Haderup.
Cuba (1): Dr. Weber.
Australia (1): Dr. Merrill.
Canada (1): Dr. A. E. Webster.
Japan (2): Drs. Chiwaki and Enomoto.
Mexico (1): Dr. Rojo.
Brazil (1): Dr. Chapot-Prevost.
Argentine Republic (1): Dr. Etchepara-borda.
Chile (1): Dr. Valenzuela.
Colombia (1): (To be appointed.)
Uruguay (1): Dr. Burnett.

With regard to countries not represented in this list, the committee adopted the following resolution:

"RESOLVED, That the Executive Council shall have the power to add to its number upon the application of any country not having representation."

Your committee recommends the adoption of the following resolution from Section IV, proposed by Dr. Godon:

"RESOLVED, That public dental services should be organized in hospitals, schools, factories, etc., and wherever the poor are medically treated, that they may receive not only urgent medical and surgical attention (whether as to dressings, consultation, temporary fillings, or extraction) but that so far as possible thorough treatment be given to restore the dental organs by means of the resources which modern dentistry affords and such as is employed in the private practice of dentistry and as is the case in the dispensary practice of general medicine and surgery. That is to say, not emergency treatment only, but thorough dentistry is demanded for the poorer classes."

We also recommend the adoption of the following resolution, offered by Dr. Aguilar:

"*Whereas* it has come to the knowledge of the Fourth International Dental Congress that at the Fifteenth International Congress of Medicine to be held in 1906 at Lisbon, Portugal, no provision has been made for a section on Odontology and Stomatology; and

"*Whereas* the suppression of this important section, which in the past international congresses of medicine has contributed largely to the advancement of medical knowledge, would be a serious injury to the profession which it represents; therefore be it

"RESOLVED, That the Fourth International Dental Congress requests the committee of organization of the Fifteenth International Congress of Medicine to take into consideration the importance of odontology and stomatology as a department of medical science and art, and make such provision as will maintain its representation as heretofore."

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* At the meeting of the British Dental Association at Southport, May 20, 1905, the following were elected: Messrs. J. Howard Mummery, W. B. Paterson, Walter Harrison, G. G. Campion, and William Guy.

Your committee would also recommend the adoption of the following resolution offered by Dr. Truman W. Brophy, chairman of the Committee of Education, Nomenclature, Literature, and History of the Fourth International Dental Congress:

"RESOLVED, That an International Commission be appointed by the F. D. I. for the next period, upon International Nomenclature and the preparation of a list of professional terms which shall be interchangeable and translatable into English, German, French, and Spanish; to report at the next international dental congress."

Your Committee also recommends the adoption of the following resolution, proposed by Dr. Jenkins:

"*Whereas*, James H. Worman, Consul-general of the United States at Munich, has for several years, in a spirit of complete disinterestedness and at great personal expense, carried on a successful campaign against bogus dental diplomas, and has also made great efforts to secure international comity in regard to reputable dental degrees; and

"*Whereas*, in all this labor he has received the constant sympathy and support of the government of the United States; therefore be it

"RESOLVED, That the Fourth International Dental Congress presents its thankful acknowledgments to the United States Government and to Consul-general Worman, and expresses the hope that Consul-general Worman will not abandon the European field, but will still continue to give the cause of international comity in legitimate dental degrees his powerful support."

The Committee on Resolutions heartily indorses the labors of Dr. Wms. Donnally in this country in the direction of obtaining proper dental services for the army and navy, and recommends the adoption of the resolution which has been offered by the gentleman himself.

J. Y. CRAWFORD,	J. A. CHAPPLE,
CH. GODON,	J. W. DAVID,
FLORESTAN AGUILAR,	N. S. JENKINS,
L. C. BRYAN,	E. SAUVEZ,
L. D. SHEPARD,	J. S. MARSHALL.

Dr. CRAWFORD. Your committee recommends the adoption of the following as an addition to what was suggested by the Federation and which you heard at our opening meeting: [Reading the resolution by Dr. Godon, from Section IV, in regard to dental services in hospitals, schools, factories, etc., as contained in the foregoing report.]

The PRESIDENT. The question is on the adoption of the resolution just read by Dr. Crawford.

Dr. A. H. PECK, Chicago, moved the adoption of the resolution, which was seconded, and the resolution was adopted.

Dr. CRAWFORD next read the resolution in relation to the Fifteenth International Congress of Medicine to be held in 1906 at Lisbon, Portugal, as contained in the report.

The PRESIDENT. What will you do with this resolution?

Dr. A. H. PECK, Chicago, moved the adoption of the resolution, which was seconded, and the resolution was adopted.

Dr. CRAWFORD. Your committee would also recommend the adoption of the resolution offered by Dr. Brophy.

Dr. E. C. KIRK, Philadelphia, moved its adoption; the motion was seconded, and the resolution adopted.

Dr. CRAWFORD. The next resolution that is embraced in the report which was provisional, was in reference to the matter referred to in Dr. Jenkins' resolution. The committee recommends the adoption of the resolution as read by Dr. Jenkins.

It was moved that said resolution be adopted; the motion was duly seconded, and the resolution was adopted.

Dr. CRAWFORD. The Committee on Resolutions heartily indorse the labors of

Dr. Williams Donnally in this country in the direction of obtaining proper dental service for the army and navy, and recommends the adoption of the resolution presented by Dr. Donnally of Washington, D. C. [See page 57.]

It was moved and seconded that the resolution be adopted. Carried.

Dr. Ch. Godon, Paris, France, moved that a vote of thanks be extended to all the officers and members of the International Dental Federation in foreign countries and in America who have given their support to the Executive Council of the F. D. I. during the past four years.

The motion was seconded and carried unanimously.

Dr. Crawford asked the unanimous consent of the convention to call a conference of the Committee on Resolutions in the rear of the platform. There being no objection, consent was granted.

Dr. E. C. Kirk, secretary, read an official communication addressed to the president and members of the Fourth International Dental Congress from the Central Verein Deutscher Zahnärzte respectfully inviting the members of the Fourth International Dental Congress now convened, to hold the Fifth International Dental Congress at Berlin, Germany, in connection with the celebration of the fiftieth anniversary of that society, in 1909.

Dr. E. C. Kirk. In view of this communication, Mr. President, I offer this resolution:

Resolved, That when we adjourn, we adjourn to meet as the Fifth International Dental Congress in Berlin, Germany, in 1909.

Dr. Truman W. Brophy, Chicago. I take pleasure in seconding that motion.

The motion was unanimously carried.

Dr. Crawford. Mr. President, in connection with the report that was made recently from the International Dental Federation which contemplated the idea of creating an official board of members of the Federation to be composed of fifty persons appointed by this congress, with the various national apportionments, commencing with the highest number, five, and ending with the lowest number, one: When your Committee on Resolutions perfected its report that list had not been completed so far as this organization is concerned by the naming of the men from the United States. They have since been elected in this hall this morning, and I have asked unanimous consent that the names of the members thus elected in conformity with the request of the Federation, be added. Now then I have asked Dr. Godon, as he is more familiar with the names in foreign countries, to read the list, for your formal ratification.

Dr. E. C. Kirk then read the names of the members from the United States, as follows: Dr. Thorpe, Dr. Carr, Dr. Harlan, Dr. Kirk, Dr. B. Holly Smith.

Dr. Ch. Godon, Paris, read the names of the members from all foreign countries. [See page 58.]

Dr. Crawford. I now move the adoption of our report.

The motion to adopt the report was seconded and carried.

Dr. Crawford, chairman, asked for a conference with the members of the Committee on Resolutions.

The President. Please give your attention to the report from the Program Committee.

Dr. A. H. Peck, Chicago. Mr. President, the Program Committee recommends for reading before the general body the essay of Dr. Eugene S. Talbot, of Chicago, which in the contest for prizes received honorable mention, the subject being "Anatomic Changes in the Head, Face, Jaws, and Teeth in the Evolution of Man."

The PRESIDENT. Ladies and gentlemen, I have the pleasure of introducing to you Dr. Talbot of Chicago.

The President at this point requested Dr. Florestan Aguilar, Madrid, Spain, to preside as honorary chairman.

Dr. EUGENE S. TALBOT, Chicago, Ill., then read the following paper:

[Transferred from Section I.]

Anatomic Changes in the Head, Face, Jaws, and Teeth in the Evolution of Man.

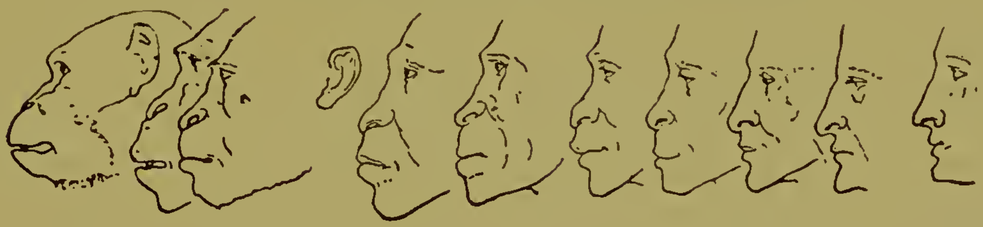
By **EUGENE S. TALBOT, M.S., D.D.S., M.D., LL.D., Chicago, Ill.**

[AWARDED "HONORABLE MENTION" BY COMMITTEE ON PRIZE ESSAYS.]

IN his evolution man has undergone many changes. Some structures have been added, others lost. From Thales to Darwin, the attempt was made to discover the laws governing these changes. Empedocles, 495 B.C., outlined from his study the doctrine of evolution, involving therein the survival of the fittest. Aristotle, 384 B.C., viewed the relation of the structures and organs to each other from the standpoint of a hypothetic law of economy of growth by which structures were sacrificed as entities to benefit the organism as a whole. Goethe in 1809 and St. Hilaire in 1818 still further cleared this law of obscurity.

Study of this revealed a struggle for existence between organs with interaction consequent on use and disuse of structures. Camper employed this law in his use of the ideal face of the Apollo Belvedere to illustrate the gradual retreat of the jaws from lower to higher types of face. (Fig. 1.)

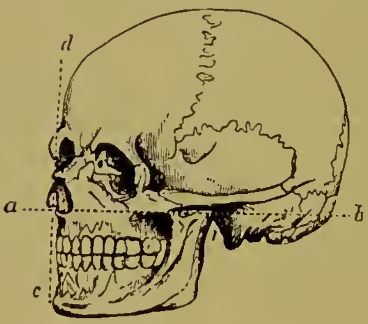
FIG. 1.



The facial angle of Camper, Cuvier, Cloquets, Jacquarts, the Munich-Frankfort angle, and that of Topinard, involves merely the bones of the face, not the inferior maxilla. Most authors dealing with prognathism and orthognathism include, therefore, merely the superior maxilla in the conception. Stomatologic specialists must include the inferior maxilla in the outline in order to determine what may or may not be required in improving the jaws and teeth. In my studies of the etiology of irregularities of the jaws and teeth I have simply extended the facial line downward below the lower jaw. (Fig 2.) An imaginary perpendicular line dropped from the superciliary ridge below the lower jaw decides whether the jaws be prognathous or orthognathous.

The ideal face of Camper is a norm which shows where anatomic progress ceases and pathologic begins. At one stage in the evolution of man the eyes, face, nose, jaws, and teeth were most essential in obtaining food for the nourishment of the body, and equally so in sexual selection. As man developed, owing to brain increase, he acquired the power of obtaining and digesting food with less expenditure of physical strength. Disuse of the jaws and teeth, owing to their becoming less a factor in food-getting, induced atrophy.

Fig. 2.



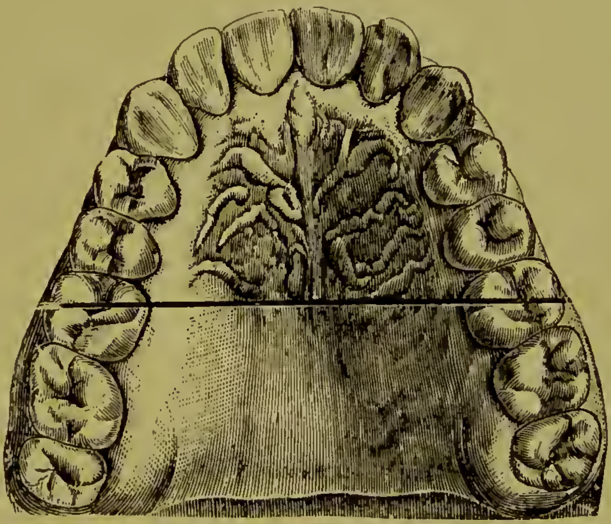
The modern North American negro is an apt illustration. The evolution of the negro in North America has been most wonderful, mentally and physically. In two hundred and fifty years he has developed from primitive conditions to equal in many cases the Caucasic. Typically the negro is long-headed (dolicho-cephalic), with a face extending beyond the perpendicular line (prognathous). At the present time, nearly fifty per cent. of negroes have faces on the line. Up to this period of facial atrophy the cavities of the nose were large enough for the purpose of breathing, the jaws large enough for the teeth; the teeth rarely decayed, and interstitial gingivitis (owing to large, well-developed alveolar processes) seldom occurred.

While healthy recession is still progressing under the law of economy of growth, the perpendicular line remains the dividing line between the normal and abnormal.

Associated with antero-posterior arrest is lateral arrest of the face, which as a rule is about as great as the antero-posterior. In such cases protrusion (excessive development) of the nose and upper jaw often occurs. The lower is usually arrested. The contraction begins at the upper border of the nasal bones at their junction with the frontal, extending downward to a point midway between the angle of the lower jaw and the symphysis of the chin. Some idea of this lateral contraction is given by Mummery's measurements of ancient British and Roman skulls. These from the outer surface of one first molar to the outer surface of the other (Fig. 3) showed a width average of 2.50 inches. Measurements of Americans revealed an average of 2 to 2.19 inches in normal people, showing a difference in lateral development from those of Mummery of about 0.30 of an inch. The effect is to produce a narrow (hatchet) face.

In order of developmental atrophy of the face, the dividing line between the normal and abnormal in jaws and teeth would occur when the jaws from outside of the first molars measure from 2 to 2.20 inches and the antero-posterior atrophy brings the face on or inside the perpendicular line. In a general way these two points are the lines of demarkation between normal and abnormal. Structures which degenerate for the benefit of the organism as a whole are transitory structures. At these two points, owing to arrests of development, the stigmata of degeneracy are most marked. At these points the normal ceases and the pathologic begins.

FIG. 3.



Conditions which modify healthy degeneracy or normal atavism are ordinary and socially consanguineous marriages, intermixture of races, climate, soil, food, etc. These, however, do not produce such marked arrests and excessive development as are caused by an unstable nervous system in the parent as well as in the child.

Even folk-lore, the science of primitive man, accepts direct relation of deformities in the child to the parent. Its taboos and charms are often attempts to regulate these.

With that stage of development of the religious sense marked by assigning malign occult powers to natural objects and forces, this view of degeneracy became systematized, and exposed weakly or deformed offspring, charged to evil powers, to death. This occult conception of degeneracy is even yet a part of American folk-lore. Against degenerate children charms are still used by the "witch-doctors" among the Pennsylvania Dutch, who are on the level of culture of the early seventeenth century middle English, if not a little below it. The folk-lore of these, as embodied in Shakespeare, demonstrates, according to J. G. Kiernan,* that ere the seventeenth century the fact that "mental and moral defect expressed itself in physical stigmata was recognized and even the term used." "It is an old prejudice," Thistleton Dyer remarks, "not yet extinct, that those who are defective or deformed are marked by Nature as prone to mischief."

In "A Midsummer Night's Dream" (v. 1) Oberon† wards off degeneracy from the issue of happy lovers by the charm—

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* *Alienist and Neurologist*, 1895.

† "Folk-lore of Shakespeare."

"And the blots of Nature's hand
Shall not in their issue stand:
Never mole, hare-lip, or scar,
Nor mark prodigious, such as are
Despisèd in nativity,
Shall not upon their children be."

"So many several ways are we plagued and published for our father's defaults," remarks old Burton,* "in so much that as Fernelius truly saith, 'It is the greatest part of our felicity to be well born, and it were happy for human kind if only such parents as are sound of body and mind should be suffered to marry.' An husbandman will sow none but the best and choicest seed upon his land; he will not rear a bull or horse except he be right shapen in all parts, or permit him to cover a cow or mare except he be well assured of his breed; we make choice of the best rams for our sheep, rear the neatest kine, and keep the best dogs. And how careful, then, should we be in begetting of our children. In former times some countries have been so chary in this behalf, so stern, that if a child were crooked or deformed in body or mind they made him away; so did the Indians of old, by the relation of Curtius, and many other well-governed commonwealths, according to the discipline of those times. 'Henceforth in Scotland,' saith Hect Boëthius, 'if any were visited with the falling sickness, madness, gout, leprosy, or any such dangerous disease which was likely to be propagated from the father to the son, he was instantly gelded; a woman kept from all company of men; and if by chance having some such disease she were found to be with child, she with her brood were buried alive'; and this was done for the common good, lest the whole nation should be injured or corrupted. A severe doom, you will say, and ought not to be used among Christians; yet more to be looked into than it is. For now, by our too much facility in this kind, in giving way for all to marry that will, too much liberty and indulgence in tolerating all sorts, there is a vast confusion of hereditary diseases, no family secure, almost no man free from some grievous infirmity or other, when no choice is had, but still the eldest must marry, as so many stallions of the race; or if rich, be they fools or dizzards, lame or maimed, unable, intemperate, dissolute, exhaust through riot, as he said, they must be wise and able by inheritance. It comes to pass that our generation is corrupt, we have many weak persons both in body and mind, many feral diseases raging among us, crazed families; our fathers bad, and we are like to be worse."

The unstable nervous system of the parent which produces arrests and excessive development in the child is often due to excesses involving toxic agents. These are divisible into those belonging to the condiments, medicines, foods, and beverages, those arising from occupation, and the auto-toxemias. Tobacco, alcohol, opium, tea, coffee, and cocain, as well as lead, mercury, and brass, produce toxic effects. Excesses in a social way, late hours, etc., may produce profound systemic nervous exhaustion with auto-toxemia in the ancestor and especially the ancestress, likely to be transmitted as degeneracy to the descendant.

The acute and chronic contagious and infectious diseases in the parent, especially the mother, necessarily exert the same toxic influences upon the fetus, impoverishing it, and checking healthy nutrition.

The factors producing degeneration in the child are due to a nervous exhaustion in the first generation, which implies a practical degeneration in function, since tone is lost.

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* "Anatomy of Melancholy," sixth edition, 1652, part 1.

Every nerve cell has two functions, one connected with sensation and the other with growth. If the cell be tired by excessive work along the line of sensation or motion, the function as regards growth becomes later impaired, and it not only ceases to continue in strength but becomes self-poisoned. Each of the organs (heart, liver, kidneys, etc.) has its own system of nerves (the sympathetic ganglia) which, while under control by the spinal cord and brain, act independently. If these nerves become tired the organ fails to perform its function, the general system becomes both poisoned and ill-fed, and nervous exhaustion results. In most cases, however, the brain and spinal cord are first exhausted. The nerves of the organs are thus allowed too free play, and exhaust themselves later. This systemic exhaustion has local expression in the testicles in the male, in the womb and ovaries in the female. Through this the body is imperfectly supplied with natural tonics (antitoxins) formed by its structures, and the general nervous exhaustion becomes still more complete. All the organs of the body are weakened in their function. Practically, the neurasthenic in regard to his organs has taken on a degenerative function, albeit not degenerating in structure, since the restlessness of the organs is a return to the undue expenditure of force which occurs in the lower animals in proportion as it is unchecked by a central nervous system. Through the influence of various exhausting agencies, the spinal cord and the brain lose the gains of evolution, and the neurasthenic is no longer adjusted to environment.

Since the reproductive organs suffer particularly, children born after the acquirement of nervous exhaustion, more or less checked in development as the influence of atavism is healthy or not, repeat degenerations in the structure of their organs which in the parent were represented by neurasthenic disorders in function. As the ovaries of neurasthenic women are markedly affected by the nervous exhaustion, the offspring of these do not retain enough vigor to pass through the normal process of development.

On embryonic development, maternal environment exercises an enormous influence in the direction of arrested or progressive development. Maternal shock produces arrests of development which are not photographic conditions, but survivals of embryonic states. While maternal impressions do have an effect, it is simply in conditions of arrest and not in photographic reproductions of the alleged cause of the impression.

In intra-uterine life, periods of stress occur around which, as Kiernan remarks, the disappearing and developing tendency of organs necessarily centers. At these periods certain functions and structures are to be lost by the disappearing and others gained by the developing organs; maternal shock checks proper progress at these periods.

When systemic balance, the result of evolution, is disturbed by change in environment, the organs, as has been shown experimentally by Jacques Loeb,* do not pursue their usual growth. Such disturbances are peculiarly apt to occur during periods of stress because of the then varying relations of different organs.

Struggles for existence on the part of the different organs and systems of the body are hence most ardent during the periods of intra- and extra-uterine evolution and involution. During the first dentition, during the second dentition (often as late as the thirteenth year), during puberty and adolescence (fourteen to twenty-five), during the climacteric (forty to sixty), when uterine involution occurs in woman and prostatic involution in man, and finally during senility (sixty and upward), mental and physical defect may, as I have elsewhere shown,* be evinced in a congenital tendency which has remained latent until the period of stress.

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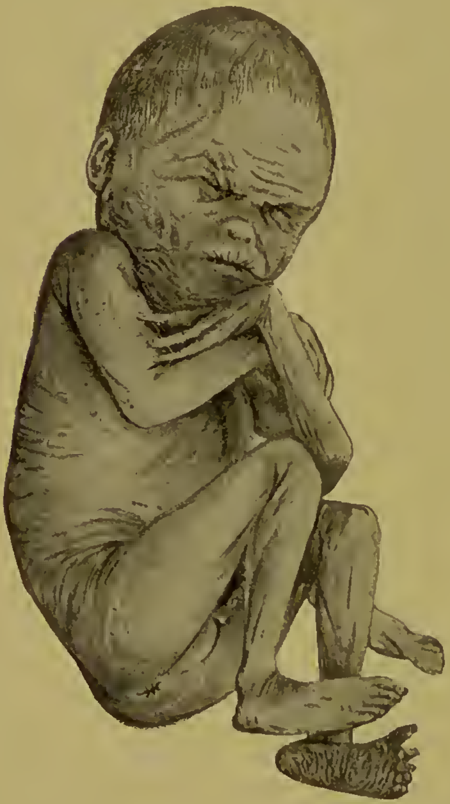
*"Untersuch. zur Physiol. Morphologie."

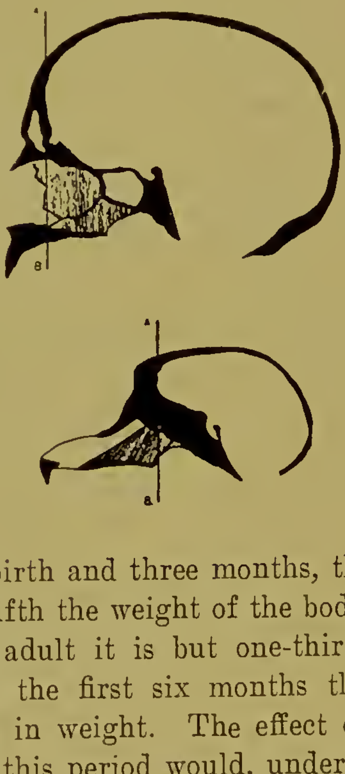
FIG. 4.



The first period of stress is the most important so far as the head, face, jaws, and teeth are concerned. It is called the senile or simian period (Fig. 4), and occurs at four and one-half months of fetal life. The influence of neurasthenia in the parent may result in a bony arrest of development shown to occur in animals by Charrin and Gley, and in man by Coolidge. The facial bones, jaws, and teeth are peculiarly liable to be thus affected. Though the effect of disease on the parent be but temporary, the child's development may be checked as to higher tendencies.

The factors entering into the struggle for existence most markedly involve the relations of the brain to the head and face. During intra-uterine life the face loses and the brain gains. During the first extra-uterine period of stress, between birth and three months, the brain is one-fifth the weight of the body, while in the adult it is but one-thirty-third. During the first six months the brain doubles in weight. The effect of stress during this period would, under the law of economy of growth, either be felt in diminution of the quality or quantity of the brain or in the preservation of these at the expense of more transitory structures like the face, nose, jaws, and teeth. This is well illustrated in the contrasted skulls here shown (Fig. 5). After birth

FIG. 5.



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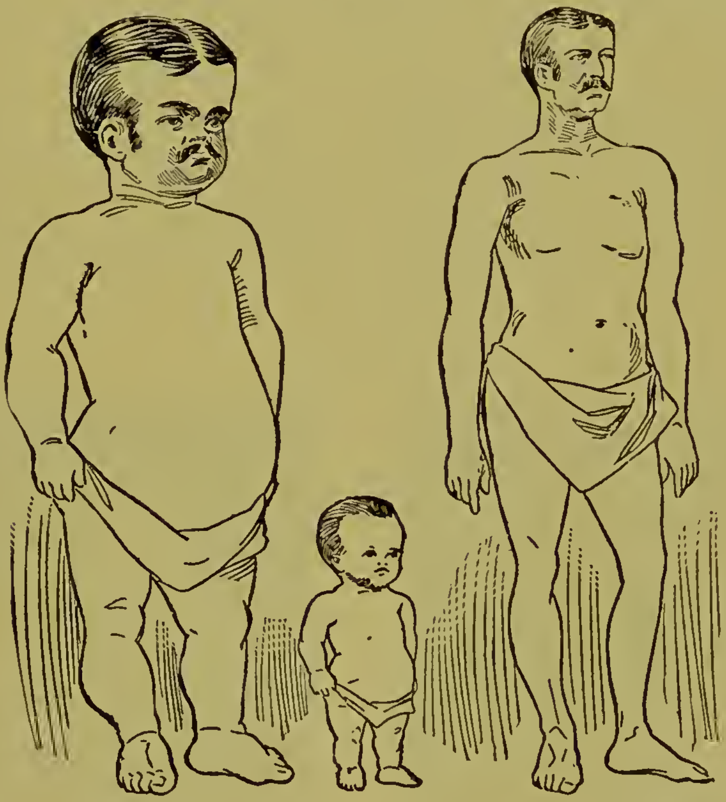
* "Degeneracy, its Signs, Causes, and Results."

the face gains at the expense of the brain. The body and face, as a whole, so gain on the growth of the brain that, as Havelock Ellis* remarks, further growth from the third year onward, though an absolutely necessary adaptation to environment, is to some extent growth in degeneration and senility. The loss of child potentialities is well shown in Fig. 6, where the perfectly developed being fulfilling the promise of the child is contrasted with the man that the child actually becomes. Struggles for existence on the part of the different organs and systems of the body are most ardent during the periods of intra- and extra-uterine evolution and involution. At the periods of sex-differentiation, and at the simian or senile period (Fig. 5), irregular balance given the struggle for existence leads to imperfect sex-differentiation or premature senility. This last often produces irregular and incomplete ossification. Since, as Harriet Alexander* has shown, degeneracy is a process of evolution leading to alteration of form because of cessation of inhibition in certain directions resultant on diminished work, it logically follows that since diminished function precedes change of structure, increased function checks the change of structure in its bichemic stage. Nay, more, structural elaboration due to gains from degeneracy may be retained while degenerate structures resume their higher functions. Hence a degenerate race may rank higher in evolution because of the beneficial variations due to degeneracy.

FIG. 6.



The structures of the face, as Minot has shown in man, are degenerate as viewed from the vertebrate type. They are structures which quite early in evolution have been sacrificed to the gains of the central nervous system. (Fig. 6.) On them, therefore, do struggles for existence between organs leave decided marks. The jaws and face are less marked in type with rise in evolution.

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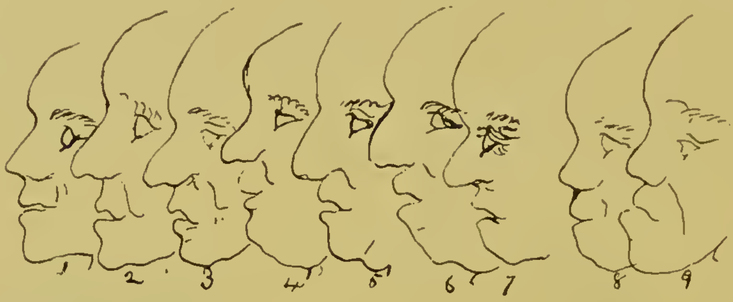
*"Man and Woman."

* *Medicine*, 1896.

Fig. 7.



The reverse phase of evolution, with which Camper did not deal, is that of which the present paper treats. This phase of evolution underlies all pathology of the face, as well as of the nose, jaws, alveolar process, and teeth. The illustrations, supplementing those of Camper, portray this reverse phase, where symmetry of the body as a whole is sacrificed to changes in the nose, jaws, alveolar processes, and teeth, so as to preserve brain gains.

Fig. 8.

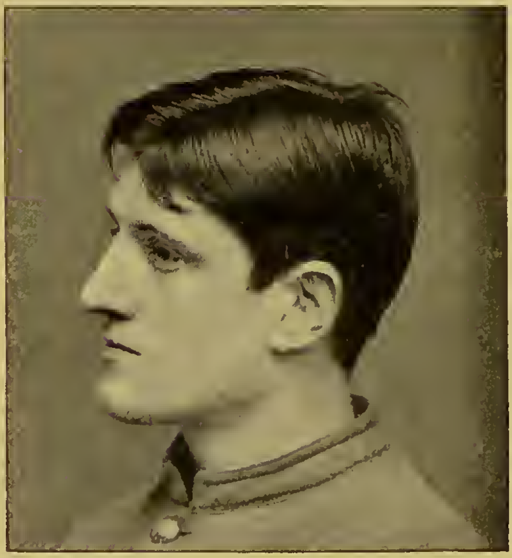
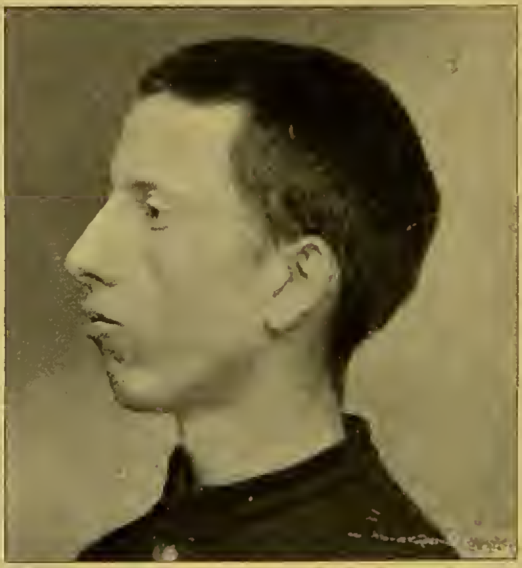


Fig. 9.



The next illustration (Fig. 7), taken from photographs of patients, accurately portray arrests of the face for the benefit of the brain. The gradual recession of the face and the forward development of the brain is a gradual continuation of Fig. 1 in the line of evolution. From the relations of this face-degeneration nearly all diseases of the nose, jaws, alveolar processes, and teeth result. In many cases reverse evolution progresses still farther, till, owing to an unbalanced nervous system and movements of the lower jaw, atavism results. Illustrations 8 and 9, in Fig. 7, exhibit a greater exaggeration of the lower jaw—a return to the anthropoid and lower negro type.

Two facial types result from arrest of development. Fig. 8 shows the arrest antero-posteriorly, while Fig. 9 shows lateral arrest. All other forms of arrest are modifications of these two. They may become either more intense or less marked.

Through phases of the evolution of man affected by an unstable nervous system, either in parent or child or both, arrests and excesses in development (degeneracies) may occur in the face, eyes, nose, jaws, alveolar processes, and teeth, and form the foundation of all pathology of these structures.

Discussion.

Dr. J. G. **Kiernan**, Chicago. The conception of health as an entity is a part of the erroneous conception of the body as an entity instead of as a compound organism. Not only does the body have certain potentialities of development which are expressed at the periods of stress, but all organs retain both embryonic and post-natal potentialities which are neither macroscopically nor microscopically demonstrable even by the finest methods. Health being a balance and dependent on the disposition of assimilable nutriment, and this balance being dependent not only on environment but on environment as affecting either embryonic or post-natal potentialities, it is a matter of mathematical demonstration that if embryonic potentialities once active for the benefit of the organ, and now latent for the benefit of the body as a whole, be stimulated at the expense of post-natal potentialities, conditions destructive of the normal balance must occur.

For this reason, as Dr. Talbot has shown, great variations occur in structures which have been variable in embryogeny and post-natal development. The face and jaws have varied enormously in mammalian development. The same is true of the teeth, as the slightest study of the subject will show. The variations within the limits of health, although constituting a pathologic factor, are sometimes enormous. To a certain extent, as Dr. Talbot has shown, the normal enlargement of the lower jaw from the small embryonic type may be exaggerated at the expense of the rest of the face while leaving the rest of the body unaffected. Developmental pathology not only underlies proper embryogeny but likewise most surgical problems.

Dr. C. L. **Hungerford**, Kansas City, Mo. I would like to say just a word. I would like to have the members of the congress ask themselves, Toward what does this paper tend? So far as I see it is an *exposé* of isolated facts. From these malformations is drawn the conclusion that man evoluted from the anthropoid ape, or the Aryan race came from the negro or the Chinese type or some other type. I wish I might be permitted to change one expression, and instead of saying a degenerate, say a degenerating race—as the negro is a degenerating race: so also is the Chinaman, the Alaskan Indian, the earlier aborigines of Australia; Spain is degenerating, and so is France; England is on her decline; various races rise and fall; America is a rising race, so are the Cubans and Japanese. To start with a point as degenerate, as I understood the essayist, and work back toward the anthropoid ape is only an argument that controverts the theory of evolution of man from the ape, showing that man can degenerate toward the ape, but not that he came up from them. The greatest of our scientists today in anthropology have decided that the Caucasian or Aryan race and the highest type of human development never evoluted from the anthropoid ape, but that the anthropoid ape is a degenerate human being. Not only is that accounted for by all science, but in all history, in all scriptures, and in all knowledge with which I am conversant. There are types that may have reverted as the result of miscegenation, but this is no proof of evolution.

The majority of these illustrations are simply malformations from hereditary and other causes. They are not true degeneracy, for that is a slow process and can only affect races, not individuals.

I did not gather just what the essayist was trying to prove. He simply illustrated certain facts, which seemed to me to tend toward the idea that man was evoluted from the anthropoid ape—an idea that I most seriously wish to controvert. I do not believe it, and I have the authority of every great scripture of the world and the greatest scientists living today. There is no such thing as evolution of a lower to a higher, unless the higher is in the lower. You cannot take ten gallons out of a five-gallon jug; you cannot evolute an ape into a god, unless the ape has a god in him; but a god can degenerate and lose his godhead and become an ape. An ape cannot become a man, not in ten million million years; and nobody ever believed it except those men who are so wedded to what might be called "text-book authority" that they are afraid of their own opinions and their own thoughts, and afraid to give to their own investigations their natural conclusions. They stick like women to the existing order, but thank the Lord that existing order has had such a volcano under it in the last three or four years that there are very few men today who are well posted in anthropology who believe in evolution of the white race from the anthropoid ape.

It is not evolution, but a mental, moral, or physical perversion of the subject or his immediate ancestors that has caused these various forms that have been illustrated. How do they take place? Here is a man with a receding chin, with a sunken nose and forehead. Nature gives expression to the soul within a man in her outward manifestation of him: when beauty takes its departure from the human face, the human face shows the way that that beauty went, whether dissipation, sensuality, or drink. When Nature expresses her thought, her divine thought, it is in the highest physical objective type in which she can find lodgment, and when she has a degenerate soul behind it she exhibits a degenerate body, and builds one in conformity therewith. The wayside flower has its little soul developed so far as it can express itself, and the higher type of flower or animal expresses its soul in its form; and when you find faces, perhaps beautiful in their childhood, now crooked, receding, sunken, blotched, and sallow, you know somewhere in that man's life his thoughts have so far retrograded that nature has stamped upon his face the true expression of what that soul is. There is no secret but what shall be revealed, and we reveal our character in our thoughts every day as we build them in our physical cells and show them up in our faces. (Applause.)

Dr. H. J. Burkhart here resumed the chair.

Dr. A. H. Thompson, Topeka, Kansas. This paper of Dr. Talbot's is an important contribution to the subject of the degenerating evolution of the face with which he has made us familiar. It is along pathological lines that he really has advanced now, and I hope that we may continue to have studies contributing to the closing of what might be called the gap between cause and effect in which neurasthenia affects the development of the face. These degenerate conditions are, of course, the result of retrogressive change, using the word "evolution" in its broadest sense. The result of this retrogressive evolution today is the reduced structure of the face, which is in fact in embryo, and is more properly called infantism because it stops at that stage and does not progress to full development as found in earlier primate forms.

The President. If no one else desires to discuss the paper, I will ask Dr. Talbot to close.

Dr. E. S. Talbot. I regret very much that it will be impossible for me, in the few minutes I have, to elucidate. It is one of the hardest things in the world to make a person who has not given much thought to this subject understand exactly what is meant by degeneracy. A person may have a degenerate brain; he may have an arrested development of brain. What is generally termed a degenerate may be a criminal, a thief, a liar, and so on. But we have degenerate structures. Man cannot evolute, he cannot develop, without losing some structures and having others develop; hence the vermiform appendix is an organ that is passing; the pituitary gland, the small ribs, the little toes, the little muscles of the ears are not being used, and therefore nature is getting rid of them for higher mental development. They are degenerative structures. It is the brain that is developing in the human race, or, as the gentleman said here, certain nations have become arrested and they are dying out. I have not time to explain it, but he is quite right about that—that a nation will go on to a certain period and if there is no new blood infused into it from other nations that nation will soon die out; if it takes a thousand years, or perhaps two thousand years, nevertheless it will do it. But here in America we have an advantage over any other nation of the globe; individuals are pouring in from all over the world, and we are intermarrying and furnishing new blood, and for that reason the brains are developing in this country, which up to a certain time, as soon as immigration ceases, and we intermarry among our own relatives, as noticed in the nobility of Europe, will then bring about mental degeneration.

But, on the other hand, the face—the teeth are not being used, the face is not being used, the eyes are not being used, the nose is not used, and that is the reason why the face is degenerating for the benefit of the brain. We usually do most of our work by machinery now; we do very little of it by hand. We do not gnaw upon trees with our teeth as the lower animals do, for instance; but the brain is developed, our work is being done by machinery, and the physical part of the human body is degenerating. We are going on in a higher evolution, and that is the reason why degeneration of the face is going right on; that is why we have irregularities of the teeth; we are going right on all the time. We are not stopping decay of the teeth in the race; we are only stopping it in individuals; we are not stopping it as a nation or as a family. Every generation that comes into this world will have more decay of the teeth than the generation before. The same is true with the irregularities of the teeth. They are going to become more prominent as we ascend the scale of evolution, because of the recession of the jaws, and because we do not use them.

This is a proper conception of the whole subject. We have to contend with decay of the teeth, with irregularities of the teeth, with interstitial gingivitis; and all of these conditions are based on this law of economy of growth. The structure of an organ is lost for the benefit of the organism as a whole. Now, then, where a parent or a child has a nervous condition we get this arrested development. It may be due to going to parties too much of evenings and sitting up nights and sleeping in the daytime; it may be due to overwork; it may be due to disease that is inherited. If, however, the mother be a strong, healthy woman she may be able to ward off these conditions that we are called upon to treat. If, on the other hand, her nervous system is unstrung and the child does not get proper nourishment, owing to an unstable nervous system, then we have all these conditions to which I have called your attention. Now that is a general outline of the subject, as I cannot go into details for want of time. I thank you very much. (Applause.)

The PRESIDENT. Ladies and gentlemen, I have the pleasure of presenting to you a distinguished guest from Brazil, Dr. Houston.

Dr. J. FRANK HOUSTON, Rio Janeiro, Brazil. Gentlemen, at the instance of some members of the congress and of your worthy president I have consented to attempt to say a few words to you in regard to the great country from which I come. I have had the pleasure of being in Brazil about twelve years, and I frequently tell my friends in this country that if the Puritan fathers who came to New England had gone to Rio Janeiro, the great and beautiful harbor on the south coast of the Atlantic, instead of to Boston, that place would have become the garden spot of the world today. My greatest regret today is that the American dentists who are in Rio Janeiro were so indifferent to the great meeting that is being held at this time here; they did not unite as they should have done and make an attempt to present to you something of the conditions which exist in that great country, which I am sure would be of much interest to many of you, because it is a field open for the dental profession and for all the professions. Anyone of ability who goes to that country will make a great success.

I regret also very much that I am not an orator, so as to be able to give you something of interest in regard to that country. On behalf of the American dentists in Rio Janeiro I wish to thank all of the noble men of our profession for the great work which they have done in this great organization, and for the advancement which they have made and of which we shall reap many results. I thank you. (Applause.)

The PRESIDENT. I now have the pleasure to present to you Dr. Bryan, who will preside during the reading of the paper of Dr. Guerini of Naples, Italy, which will be read by the secretary, Dr. Kirk.

Dr. KIRK. I wish to make an explanation in regard to this paper, at Dr. Guerini's request. It is a portion of a report to the congress committee on History. That report is a very voluminous one; it is reported in the section presided over by Dr. Brophy, and to Dr. Guerini of Naples was assigned the task of contributing an essay upon the contributions of the early Italian writers to dentistry. It was a happy choice, because perhaps no one on the continent of Europe is more qualified to speak upon that theme, or upon the question of ancient dentistry in general, and the result has been considered to be of such especial interest and merit that the communication was ordered transferred from the section to be read here before you in general session.

Dr. Kirk then read the paper by Dr. VINCENZO GUERINI of Naples, Italy, entitled "Italian Writers upon Dental Science and Their Works," as follows:

[Transferred from Section IX.]

Italian Writers on Dental Science and Their Works.

By Cav. Dott. VINCENZO GUERINI, Naples, Italy.

[AWARDED SPECIAL VOTE OF THANKS.]

IN Italy much more than elsewhere, up to a very recent period, dental art has been unjustly held in low esteem, and even in these later days nothing serious has been done in the way of dental teaching; it is therefore not to be wondered at, if in the history of dentistry Italian names figure in but scarce number as compared with those of French, German, English, and American authors. We shall see in the course of this paper that some great Italian dentists have acquired celebrity in foreign lands; for, precisely on account of the low esteem in which the profession was held among us, they abandoned Italy, despairing of ever being able to gain in their own country recognition and worthy appreciation of their talent.

In the greater number of works on general medicine and surgery, beginning with those written in Italy in the thirteenth century, one finds some chapter dedicated to dental maladies and their treatment; and while what we read in those authors may be of but little account taken by itself, nevertheless, from the point of view of the development of dental art, even that little merits consideration.

The first author worthy of mention is Bruno da Longobucco, surgeon of the school of Bologna. A treatise, written by him, toward the middle of the thirteenth century, was highly appreciated at the time of its appearance. The part relating to dental and gingival maladies is very brief. The author seems to be a great friend of the actual cautery, and advises using it as a cure for dental caries, epulis, fistulæ, and cancer of the gums. Nothing is said by him of instrumental avulsion of the teeth; he recommends, instead, as a means of making a diseased tooth fall out, a paste of flour and the milky juice of the tithymal to be applied around its root.

The circumstance that Bruno da

Longobucco, like other writers on surgery of the same period, does not mention extraction of the teeth, does not mean at all that this operation was not then in use, but only that instead of being practiced by surgeons, it was left to the so-called tooth-pullers, who generally belonged to the barber class. Indeed, in a still more ancient writer, the Arabian surgeon Abulcasis, one finds a passage to the effect that the extraction of teeth was very frequently practiced by barbers, and later (that is in the fourteenth century), the celebrated French surgeon Guy de Chauliac, in referring to dental maladies, wrote very explicitly that operations on the teeth were "particular," that is to say "special," and appertaining to barbers and "dentators."

Another ancient Italian surgeon, Guglielmo di Saliceto, who was professor at Bologna and at Verona in the second half of the thirteenth century, also says very little with regard to gingival and dental maladies, and absolutely nothing referring to surgical intervention upon those parts. For the treatment of swelling and other diseases of the gums he recommends friction with alum, mouth-washes of acetum scillæ, the application of mastic powder, and other medicaments of the same kind. To strengthen loose teeth he advises using powdered coral mixed with mastic; and to effect the prompt cessation of toothache he recommends a compound of apium seeds, opium, and henbane, to be made into pills and applied to the diseased tooth.

Lanfranchi of Milan, one of the most celebrated surgeons of the thirteenth century, although he mentions the extraction of teeth in his treatise on surgery, shows himself but little inclined to the operation, and prefers to combat dental pains by using narcotics. The extraction of molars he considers an especially dangerous operation.

Teodorico Borgognoni (1205-1298), also known under the name of Teodorico of Cervia, is the first author who speaks of salivation consequent on mercurial frictions. What he says about gingival fistulæ, or fistulæ of the maxillary region in general, is also worthy of remark. He warns, that in every case of the kind it is necessary to pay special attention to the state of the dental roots; when there is exit of sanious pus the roots are certainly affected, and all the diseased teeth must then be extracted as quickly as possible.

Pietro di Argelata or della Cerlata, professor of surgery at Bologna in the fifteenth century, wrote a treatise on surgery in six books. In this work dental maladies are also taken into serious consideration. He speaks of a great number of dental instruments, which, however, are the same as those mentioned before him by the French surgeon Guy de Chauliac. Neither do his methods of cure present anything new, being for the most part identical with those of Avicenna and Abulcasis. He attaches great importance to cleanliness of the teeth, shows what serious injury is brought about by dental tartar, counsels its removal with scrapers, the file, and dentifrice powders, and even advises the use of aqua fortis for whitening the teeth.

He says nothing about the stopping of decayed teeth; he advises, however, cleansing carious cavities with aqua fortis or else enlarging them in such a manner as to render them less liable to become the receptacle of alimentary residues.

Pietro della Cerlata treated dental fistulæ with caustics and with arsenic.

In cases of hard epulis of a malignant character he advises simple palliative treatment; in soft epulis of a benignant kind he was averse to excision, as likely to give rise to hemorrhage, and preferred instead tying the tumor, or else cauterizing it with boiling oil or other caustics, till it fell off.

Bartolomeo Montagnana, another illustrious surgeon of the fifteenth century, who taught in the University of Padua, recommended a mixture of camphor and opium as an excellent anti-odontalgic remedy. About this time the faith placed in the eradicating virtues of certain substances was disappearing little by little, but on the other hand the important principle of conservative surgery, of which the ancients had been so jealous, began to fall into neglect, and the extraction of a tooth came gradually to be considered a thing of little moment, a thing that might be practiced with the greatest indifference. Montagnana himself considers the avulsion of a decayed tooth as the best means of cure, whilst the ancients only resorted to it as a last resource. Notwithstanding this, he gave preference rather to the use of chemical caustics and the red-hot iron than to extraction when the caries was not very deep.

Giovanni Plateario, professor at Pisa in the second half of the fifteenth century, cauterized decayed teeth with a lighted piece of the wood of the ash-tree, or with a red-hot iron; he held the cauterization to be much more efficacious if the carious cavity were previously filled with theriac. Before extracting a tooth, Plateario too, as was usual, administered purgatives or bled the patient.

He has the merit of having introduced the sitting position for operations on the teeth, whilst previous surgeons made the patient lie in a horizontal position or held his head steady between their knees, as we read of in Abulcasis and other authors. He recommends besides, when one intends extracting a tooth, to take care that the surrounding air be pure, perhaps fearing lest complications might supervene through the entrance of contagious substances into the wound, when operating in places where the air was impure; or it may be that he held in mind, not without reason, that certain accidents, such as syncope or fainting, occurred more easily and were more dangerous in an impure atmosphere than in the midst of pure vivifying air.

Giovanni d'Arcoli, known also under the Latinized name of Arculanus, was professor at Bologna and at Padua in the fifteenth century; he wrote a medical work of great merit, and dedicated several chapters of the same to dental maladies, treating this subject with great thoroughness. He speaks, first of all, of the anatomy and physiology of the teeth, but runs into several errors—amongst others, on the number of the dental roots.

The following ten rules given by Giovanni d'Arcoli for the preservation of the teeth, and on which he lays great stress, form a sort of decalogue of dental hygiene:

(1) It is necessary to guard against the corrupting, within the stomach, of food and drink; one should therefore avoid all such aliments as easily spoil, and avoid after eating all that may perturb the digestion.

(2) One should avoid all that may produce vomiting.

(3) One should not eat sweets or viscous substances, such as dried figs, confectionery with honey, etc.

(4) One should not break hard things with the teeth.

(5) One should avoid all such food and drinks as set the teeth on edge.

(6) One should avoid aliments that are too hot or too cold, and especially the immediate passing from the one to the other extreme.

(7) One should not eat leeks; this vegetable has properties harmful to the teeth.

(8) One should remove all residues of food from the teeth immediately after each meal; and for this purpose should make use of small pieces of wood that are thin and very flat at the ends, but neither pointed nor sharp; the preference is given to twigs of cypress, aloe-wood, pine, rosemary, juniper, and other bitter and astringent woods; one must take care, however, not to pick the dental interstices for too long a time, and not to injure the gums or loosen the teeth.

(9) After this one should wash the teeth, making use preferably of a vinous decoction of sage or a vinous decoction of cinnamon, mastic, cubebs, juniper seeds, root of cyperus, and rosemary leaves.

(10) Before going to bed, or else in the morning, fasting, one should rub the teeth with dentifrices adapted for this purpose. And he here notes that whilst moderate friction for a short time does much good to the teeth, strengthens the gums, impedes the formation of tartar, and renders the breath wholesome; on the other hand, friction that is too violent or continued for too long a time does harm to the teeth and predisposes them to various diseases.

Giovanni d'Areoli distinguished three kinds of dental pains, namely, those depending on the gums, those depending on the substance of the tooth itself, and those depending on the dental nerve. He treats of the diagnosis of these different kinds of toothache, and in speaking of their treatment he says that when the cause of the pain resides in the gums, the extraction of the tooth is unnecessary —and indeed always harmful, for one has the loss of a tooth without obtaining the cessation of the pain; when the pain is seated in the tooth itself, extraction is sure to give relief; finally, when the dental nerve is the seat of the pain, it sometimes ceases on the removal of the tooth, at other times it does not.

In speaking of the stopping of decayed teeth, Giovanni d'Areoli says that it must not always be carried out with the same substance, but that in making choice of the material, one should have regard to the temperament of the individual and to the condition of the gums and of the tooth. However, that which is most particularly noteworthy is the fact that Giovanni d'Areoli counsels filling the teeth, in certain cases, with gold leaf.

The use of gold in dental stoppings, therefore, dates back, at least, to A.D. 1450, the period at which Giovanni d'Arcoli's book was written. It is, moreover, to be noted that in naming this mode of stopping he does not speak of it as an innovation introduced by him; indeed he merely alludes to it in the briefest possible terms, in marked contrast with the ample and particularized manner in which every other subject is treated in the book. From this we may argue that gold stoppings were already in use before the time in which Areulanus wrote, and that he simply mentions a practice of the dentists of the time. When we reflect, again, that Areulanus falls into grave error when speaking of the number of roots of the various teeth, it becomes evident that he could not have possessed any practical knowledge of dental art.

Even at that time the art was practiced by specialists, as the passage of Guy de Chauliac quoted above clearly proves—in saying that dental operations appertain to barbers and "dentators"—and one may undoubtedly deduce from that author's own work, wherein the various dental operations are spoken of and a great number of instruments for the carrying out of them are named, that the dentators or dentists of that time were not simply tooth-pullers.

The cases in which the extraction of a tooth is indicated are, according to Giovanni d'Areoli—(1) When the pain is persistent after all other means of cure have been tried. (2) When there is danger of the disease being communicated to the neighboring teeth. (3) When the tooth is a hindrance to speech or to mastication.

It is also to be noted that in Giovanni d'Areoli's book we find the first mention of the instrument called the "pelican," which remained in use for so long a time, undergoing a great number of modifications, and finally giving origin to the key of Frère Côme, the key of Garengeot, and the English key.

Another circumstance, however, renders Giovanni d'Areoli's book of still greater importance for the history of dentistry. One hundred years after the date at which this author wrote, the German surgeon Walther Hermann Ryff published a pamphlet in which, for the first time, dental maladies, their prophylaxis and treatment, are dealt with independently of general medicine and surgery. Ryff is therefore considered as the initiator of dental literature properly so called, and his book, of which the copies now extant are exceedingly rare, has been the object of accurate study, especially on the part of Dr. Geist-Jacobi, who has made known to the dental world the contents of this old pamphlet, bestowing on its author the highest praise. Now, by comparing all the passages of Ryff's book made known by Geist-Jacobi with Giovanni d'Areoli's work, I have been able to establish that it contains absolutely nothing original, for all that is worthy of note in it has been translated *ad litteram* from the work of the above named Italian author, written a hundred years before!

The celebrated surgeon Giovanni da Vigo (1460-1520) wrote an excellent treatise on general surgery, in which the part relating to dental and gingival affections is treated briefly, but in substance better than by preceding authors, for many useless and even ridiculous things current are by him passed over in silence altogether, and only practically useful methods of treatment are spoken of, and in a clear and simple manner. Thus, in what relates to the treatment of caries, he only remarks that "The decayed part of the tooth must be entirely removed by means of a drill, a scalpel, or other proper instrument, and then, to preserve the tooth, the carious cavity must be filled with gold leaf."

Many Italian anatomists of the sixteenth century studied the anatomy and embryology of the teeth very carefully, thus contributing most importantly to the progress of dental science.

Gian Filippo Ingrassia (1510-1580) was perhaps the first to make researches into the development of the teeth, and to discover the germs from which they are derived.

Matteo Realdo Colombo of Cremona, the successor of Vesalius in the chair of anatomy at Padua, combated the erroneous belief that the teeth form in the alveoli only a short time before their eruption. Having dissected the jaws of a great many fœti, he always observed that the teeth existed in them already, for which reason he was able to affirm with all certainty that the teeth begin to develop during intra-uterine life.

The highly celebrated anatomist Gabriel Fallopius (1523-1562) of Modena made accurate and very happy researches about the development of the teeth; he published the results of his studies in a book, "Observationes anatomicæ," published at Venice in the year 1562, the same year in which he died.

By his investigations he demonstrated the fallacy of Vesalius' opinion that the permanent teeth develop from the roots of the deciduous ones. He was also the first to speak in clear terms of the dental follicle. "The teeth," says Fallopius, "are generated in two periods of time, the first in the womb, after the formation of the jaws, and the second in the extra-uterine life, before the seventh year. At the time of birth, the first teeth are still imperfect, without roots, completely inclosed within the alveoli, and constituted of two parts, one osseous and hard, the other soft. In fact, the surface by which they erupt is hard and concave, the other part, instead, is soft and damp, and wrapped round with a tender membrane. Little by little, however, this soft part becomes bony and forms the root of the tooth."

Fallopius refers to having observed that the permanent teeth originate in the following manner: "A membranous follicle forms within the bone; this follicle is provided with two apexes, one deeper, to which is appended a small nerve, a small artery and a small vein; the other apex, more superficial, is prolonged by a thread or small cord like a tail. This cord reaches to the gum, passing through a very narrow foramen in the bone. Inside the follicle a special white substance is formed, and afterward from this the tooth itself, which at first is bony only in the part nearest to the superficies whilst the lower part is still soft, precisely in the same way as has been described for the deciduous teeth. Each tooth comes forth making its way through and dilating the narrow foramen through which the *tail* of the follicle passes; and this holds good for the deciduous as well as for the permanent teeth."

Fallopius also had the merit of having called attention to the analogy existing between the development of the teeth and of the feathers of birds, thus being beforehand with Duverney, who demonstrated a century later that the teeth have in their mode of development a great analogy with all epidermic appendages (nails, hair, feathers, horns).

Another celebrated anatomist of the sixteenth century, Bartolomeo Eustachio, made long and most accurate research on the teeth and on their development, and in 1563 published a work entitled "Libellus de dentibus" (little book on the teeth), which is from every point of view a masterpiece, and marks a notable progress in the anatomy, the physiology, and the embryology of the dental system.

The high value of Eustachio's researches has induced a French surgeon to perpetrate a plagiarism, a fact which so far as I know has never been unmasked. but which I myself have had occasion to examine. The name of Urbain Hémard has a certain celebrity in the history of dental art, as being that of the author of the oldest dental monograph published in France. It appeared in 1582, that is about twenty years after Eustachio's book, and bears the title. "Recherche de la vray anathomie des dents, nature et proprietez d'icelles, où est amplement discouru de ce qu'elles ont plus que les autres os; avec ques les maladies qui leur adviennent et les remèdes." Now, by comparing Urbain Hémard's book with that of Eustachio, I have found undoubted proof that Hémard, instead of carrying out researches of his own on dental anatomy, as he wants us to understand, merely translated, and for the most part literally, the most important portions of Eustachio's book.

This fact, which is very similar to the other already related with reference to Giovanni d'Arcoli and the German surgeon Ryff, demonstrates the great esteem which the Italian authors enjoyed at that time, as well as the great influence they exercised on the early period of the development of dental science.

The celebrated Fabrizio da Acquapendente (1537-1619) in a treatise on surgery speaks of the affections of the dental system succinctly, but with great order and clearness, thus enabling us to form a precise idea of the state of dental surgery toward the end of the sixteenth century.

According to this author the principal dental operations are—(1) The forcible opening of the dental arches in cases of continued constriction of the same, in order to prevent the patient dying of hunger. (2) The cleaning of the teeth. (3) The medicating of carious cavities. (4) The filling of carious cavities with gold leaf. (5) The resection of teeth that have erupted in abnormal positions. (6) The planing down of unevenness, or dental spikes. (7) Extraction.

He speaks briefly of all these operations and also alludes to dental prosthesis and palatine obturators, and further enlarges upon gingival maladies and the mode of treating them.

In an excellent work on the anatomy of the bones, published in Rome in 1689, Domenico Gagliardi treats very ably both the anatomy of the teeth and also the structure of the several parts of which these organs consist. He considers the enamel as formed by parallel fibers which during the period of formation secrete a concretable juice, *sui generis,* that acquires a consistence much greater than that of the bones. He also says that he has succeeded in extracting sparks from teeth by rubbing them hard together, or better still with a steel.

Amongst the Italian authors on dentistry who wrote in the eighteenth century, Guiseppe Lavini and Antonio Campani deserve particular mention.

Lavini published at Florence, in the year 1740, a very good work entitled "Trattato sopra la qualità dei denti, col modo di cavarli, mantenerli e fortificarli."* Campani wrote another treatise on dentistry, "Odontologia ossia Trattato sopra i denti."† This work was also published in Florence, in the year 1786, in a very elegant edition and illustrated with thirty-six tables very neatly presented. It must, however, be confessed that these two books, although published posterior to Fauchard's classical work, do not in the least show progress—in fact they are inferior to it in several respects.

In the first half of the nineteenth century, the dentists who published writings of any value were few. The only authors who seem to me worthy of mention are—Vittorio Cornelio, who published between 1813 and 1821 several writings on caries and other dental subjects, and besides these some statistical studies on dental maladies in Piedmont; C. Tagliaferro, who published at Turin in 1814 a short treatise on odontology; L. Fattori, who was the first (1825) to counsel the use of the trepan as a means of destroying the dental nerve in many cases of caries, whilst previously to this, recourse had generally been had to the red-hot iron or the chemical caustics. Fattori published at Florence a good treatise on dentistry that went through several editions, the last of which bears the date 1843.

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* "A treatise on the quality of the teeth, with the mode of extracting, maintaining, and fortifying them."

† "Odontology, or a Treatise on the teeth."

In the latter half of the nineteenth century, and especially during the last twenty years, dental publications gradually increased in number. However, I prefer not to enter into these, because, as for the most part they issue from the pen of living Italian authors, my judgments might perhaps be suspected of partiality.

I will now terminate this brief review by alluding to some Italian dentists who gained a high reputation abroad, and who became the authors of notable works on dentistry in the language of the country where each respectively had taken up his abode.

One of these dentists was Bartolomeo Ruspini, who exercised the profession in London with great success for above thirty years. He was patronized by all the greatest personages of the kingdom, and also by the royal family, from whom he received special marks of distinction. He acquired so conspicuous a position that he was able, with the product of his work, to found an orphanage that was called by his name, being moved to do this by his great love for children, whose dental maladies and disorders had always been objects of particular study for him during his lifetime. In 1768 he published "A Treatise on the Teeth, their Structure and Various Diseases." This book was remarkably well received and went through a number of editions, the last in the year 1797. Ruspini did not, in reality, contribute very much to the development of dental science. He is, however, to be specially remembered as the inventor of a very good mouth-mirror, a means of examination which afterward gradually came into general use.

Another Italian, Ricci, acquired great celebrity at Paris, where he practiced the profession at the end of the eighteenth and beginning of the nineteenth centuries. He introduced notable improvements into the manner of inserting pivot teeth, into the construction of springs for artificial dentures, and into other parts of odontotechny. He was also the author of several works, the most important of which was his "Principes d'Odontotechnique," published in 1790.

The Italian dentist Maggiolo, in collaboration with the French physician Jourdan, published a work of considerable merit at Nancy in 1807, entitled "Manuel de l'Art du Dentiste." This book, written for the most part by Maggiolo, is almost entirely dedicated to dental prosthesis, which subject had never been treated in a detailed manner by anyone before him; Maggiolo's work may therefore be considered as the first of its kind. The book was intended to serve as a practical guide to students of dental art, principally in all that relates to prosthesis; and it must without doubt have been of the greatest utility, from the clear, precise, and complete manner in which dental prosthesis is therein treated. According to Professor Lemerle, of the Dental School of Paris, Maggiolo was the first *prothésiste* of his time, and his book gave a powerful impulse to the progress of dental prosthesis.

Amongst the Italian dentists who exercised the profession in other countries, the name that takes first rank in the history of dentistry is that of Fonzi, for he, as is well known, had a most important share in the invention of mineral teeth, which invention is generally attributed to Dubois de Chemant, although some consider him a plagiarist and maintain the chemist Duchateau to be the real inventor; others, finally, declaring that both of these were merely precursors of Fonzi, to whom the credit is practically due. Impartial justice, however, obliges us to say that this important invention is due not to one alone, but to all three of these men. The fact is that Duchateau was undoubtedly the first who had the idea of making porcelain dentures, and Dubois de Chemant first succeeded in putting the idea into practice; but the prosthetic pieces of his making were in one sole block of porcelain representing at the same time the teeth and the gums. Fonzi, finally, manufactured mineral teeth properly so called—that is, separate teeth intended to be fixed on metallic bases. Dubois de Chemant's system of manufacture was as inferior to that of Fonzi as printing by means of wooden blocks as compared with movable types. Whilst Dubois de Chemant only made dentures for given individuals, Fonzi manufactured, as is done at the present day, assortments of mineral teeth with which dentures could be constructed for anyone and everyone.

These teeth were furnished with small clamps of platina, inserted in the mineral paste before it was baked, and by means of which the teeth could be soldered to the metallic base. No one had conceived the idea of manufacturing teeth of this kind before Fonzi. Besides this, he discovered how to imitate the semi-transparency peculiar to human teeth, and to give a great variety of shades to the paste, so as to be able to make the mineral teeth harmonize in color with the natural teeth of the various individuals. In fact, Fonzi introduced enormous improvements into dental prosthesis, as we learn from his own writings and as was fully recognized by the Academie de Médecine, and by the Athénée des Arts of Paris, which latter body conferred on him a medal and a crown in recognition of his high merits.

I have here essayed to prove, and I hope successfully, that notwithstanding the relative poverty of her dental literature, Italy has largely contributed to the development of dental art and science. Three names alone, of those cited by me, are sufficient to prove this: that of Giovanni d'Arcoli, the first author who speaks of gold fillings; that of Eustachius, whose excellent treatise on the anatomy of the teeth represents a record in the history of dental science; and that of Fonzi, who, as we have just seen, was the first to manufacture mineral teeth to be mounted on metallic bases.

Discussion.

Dr. Bryan, Chairman. Gentlemen, you have heard the very valuable paper of Dr. Guerini, in which he gives us some most interesting points. Are there any remarks to be made on this paper?

Dr. Chas. McManus, Hartford, Conn. Allow me to take the privilege of saying that we have listened to a very masterly paper by a very highly educated gentleman from Italy. He is an authority on a subject of great interest to an international congress. I desire to say that this distinguished man has followed out his early work in the history of dentistry among the ancient peoples of Italy, and has now carried on his careful investigations through a more modern period, bringing it down to the present day. If it be possible for him to continue his work and show us the history of dentistry during that almost unknown period of the middle ages he will have made an almost complete history of the dentistry of his country. American dentists will have to wait many years before they will be able to do the same for their own country.

Dr. TRUMAN W. BROPHY, Chicago. I would like to say that the author of this paper, Dr. Guerini, has taken the pains and gone to the expense of bringing to this congress an exhibition of ancient dentistry which I believe will be a revelation to many of those who have labored under the impression that fixation of teeth in the form of bridges is a comparatively modern art, and I trust that those who have not taken advantage of examining this very notable exhibition, which may be found on this floor, will do so. They will probably never have another opportunity to see the work of the Etruscans, dating back to a time which I cannot name, but far back in ancient history—showing that dentistry is not by any means a modern art, but antedates by many years the beginning of the Christian era. (Applause.)

Dr. L. P. HASKELL, Chicago. The Etruscan art extends back 2500 years. I have seen several of Dr. Guerini's specimens; it is practical bridge work—and bridge work, you know, is the most recent production of American art; but when you go back 2500 years we find practical bridge work done by the ancients.

The CHAIRMAN. Any other remarks?—if not the paper will be passed.

Dr. EMMA EAMES CHASE, of St. Louis, Mo. Before closing with the paper I would like to make this motion:

RESOLVED, That the Fourth International Dental Congress present its compliments and thanks to Dr. Guerini for bringing this valuable collection of historical dentistry, and for his very valuable addition to the history of dentistry.

The motion was duly seconded and unanimously carried.

Dr. VINCENZO GUERINI, Naples, Italy. I cannot speak English very well, you know, but I would say a few words. I am very glad to see that my communication is well accepted, and I thank you very much for the kind words you have said about me and my work. (Applause.)

The president, Dr. H. J. Burkhart, here resumed the chair.

Dr. CRAWFORD. The Committee on Resolutions has a supplementary report to offer. There has been referred to the committee a communication from Section IV in reference to the matter of dental hygienic instruction of the school children of the nations of the earth, and we concur in the sentiments expressed in the resolution, but as it has been provided for in the work of the Federation in the reports on the subject of education, the committee ask that it be referred to the Federation for their supervision and management.

The PRESIDENT. If there be no objection it will take that course. Hearing none, it is so ordered.

The general session then adjourned until September 3d, at 10 A.M.

FOURTH GENERAL SESSION—Saturday, September 3, 1904.

The president (Dr. H. J. Burkhart) having called the meeting to order at 11 A.M., stated that this was the last session of the Fourth International Dental Congress, and introduced Dr. Thompson, the first vice-president.

Dr. A. H. **Thompson**, Topeka, Kans. I appreciate the honor the congress has bestowed upon me. I may say that I live in the western part of the great Louisiana Purchase, the acquisition of which is the occasion of this great Exposition. I think that if Napoleon had the same grace of manner as the foreign delegates have, it is no wonder that he was able to inveigle Thomas Jefferson into buying this little piece of real estate.

The **President**. I now present to you the retiring president of the National Association, Dr. Chittenden of Wisconsin.

Dr. C. C. **Chittenden**, Madison, Wis. This is an entirely unexpected honor in addition to the one which was conferred upon me at the first meeting of this congress. I had the honor to be given at that time the privilege of welcoming the congress in the name of the National Dental Association. I now have the honor of congratulating the officers of this congress, the organization committee, and everybody connected with the various sections. I think there is occasion to congratulate them upon the success that has followed their efforts. I want to congratulate everybody on the results of the labors of this congress.

The **President**. I now have the pleasure of presenting to you the newly elected president of the National Dental Association—the distinguished gentleman from Boston, Dr. Boardman.

Dr. **Waldo E. Boardman**, Boston, Mass. I do not think I can make a speech as complimentary and as able as the gentleman who has just taken his seat. But I do want to say that the organization committee, of which I am a member, has worked hard and traveled over the United States to committee meetings during the past two years and spent a great deal of time and money, and each and all of that committee deserve great credit for their labors.

The **President**. I now have the pleasure of asking Dr. Peck, the secretary of the National Dental Association, to address you.

Dr. A. H. **Peck**, Chicago, Ill. I can only say that I am very grateful to all who have lent their assistance in this great work which we have undertaken and carried out to a very successful issue. Different individuals with different temperaments and different characteristics worked along different lines, and I am sure that no members of this great and grand profession of ours have ever had for one moment any thought except for the very best interests of this congress. Everything that has been done has worked out to the success of the Fourth International Dental Congress. As chairman of the Program Committee I have had comparatively little work to do, but what there was I have tried to do to the best of my ability, and I must say in that connection that our secretary-general is perhaps deserving of more credit than I am, because he has done the greater portion of the work of the position. I am thankful to all who have lent their assistance to this work.

The PRESIDENT. We will now give attention to the report of the Committee on Resolutions.

Additional Report of the Committee on Resolutions.

Dr. J. Y. CRAWFORD, Nashville, Tenn., then read the following report:

Mr. President, and Members of the Fourth International Dental Congress:

Your Committee on Resolutions begs to report the following:

Whereas, the success of the Fourth International Dental Congress has been very largely due to Drs. H. J. Burkhart, president, E. C. Kirk, secretary-general, M. F. Finley, treasurer, and the other general officers, and especially the chairman of the finance committee, Dr. C. S. Butler, Buffalo, and the chairman of the committee on conference with state and local societies, Dr. J. A. Libbey; and

Whereas, the rulings of our presiding officers have been eminently fair and satisfactory, we take this occasion to express our gratitude and appreciation of the same; and further, be it

RESOLVED, That much of the enjoyableness and high entertainment, social, moral, and professional, is attributable to the efficiency of the local committees in the city of St. Louis, and especially to Drs. Conrad, Thorpe, Fuller, Bowman, LeCron, and others, we desire to express our appreciation and gratitude. To the management of the Louisiana Purchase Exposition, under the direction of President Francis, ably assisted, especially in the work of organizing and directing international congresses, by Mr. Howard J. Rogers, we take great pleasure in extending our best appreciation of their very timely and generous assistance in creating and carrying to a successful termination this the Fourth International Dental Congress in the world. And to the official members of the Fédération Dentaire Internationale in attendance from foreign countries, who by their experience and great information on the subject of international dental subjects and interests have been so gracious in affording counsel, we would express our most hearty gratitude and thanks. We would express our high appreciation of the efficiency of the department of registration and bureau of information under the supervision of Dr. R. I. Pearson in connection with the *Dental Cosmos*. We would also express our thanks to the dental colleges of St. Louis for their assistance in furnishing chairs, engines, etc., for the clinic that has been such an eminent success under the management of Dr. J. P. Gray and his efficient corps of assistants. And to all others who have by sentiment or material support and sympathy given encouragement in any tangible form to the development of the now completed work of this great meeting, we also in this public and formal manner extend our profoundest appreciation and thanks. And be it further

RESOLVED, That the organization committee be instructed to prepare and present to Dr. H. J. Burkhart, president of the congress, a suitable and substantial testimonial in recognition of his untiring and most efficient services, in bringing together in such harmonious relations, every detail of this congress.

(Signed) J. Y. CRAWFORD,
Chairman,
LYMAN CURTIS BRYAN,
Sec'y Com. Resolutions.

Dr. J. Y. CRAWFORD. I move the adoption of these resolutions.

Dr. CH. GODON, Paris, France. I second the motion.

Motion carried.

Dr. WM. CONRAD, St. Louis, Mo. I would suggest in addition to the resolutions offered, that this congress extend its thanks to Mr. Lyman T. Hay, manager of the Jefferson Hotel, for his very kind, courteous and efficient service in making the banquet at his hotel a success.

Dr. Crawford. I move that this be accepted and that the meeting acting as a committee of the whole incorporate it in the resolution.

Motion carried.

Dr. E. C. Kirk, Philadelphia, Pa. There is an aspect of this congress which we have all realized and appreciated, and yet I question whether those who have appreciated the point about which I am to speak are in a position to know just how it came about. I refer to the international character of this gathering and the spirit of international comity which has developed here. I wish to emphasize the fact that from the beginning of the effort at organization when an appeal was made to the dental profession of Europe, the response in every direction was enthusiastic. No one so well as myself can understand the enthusiasm, the untiring labor, the earnestness of the chairman and members of the European committees on publicity and propaganda that had the organizing of this movement in Europe. They have helped to the consummation of the result which is not only measured by members and by the quality of the output of the program of this congress but in the greater result of these international gatherings—the solidarity of the dental profession throughout the world. These men have greatly contributed to the success of this congress; and I therefore move that the report be still further amended, and that the foreign publicity and propaganda committees established in each country for the development of the work of organization of the Fourth International Dental Congress be severally included in our vote of thanks.

Dr. Crawford. I ask the unanimous adoption of that amendment by the meeting acting as a committee of the whole.

Amendment adopted.

Dr. Conrad. I would suggest that we extend our thanks to the *American Dental Journal* for publishing daily the program of this congress.

Dr. Crawford. I move that this be accepted by the meeting as a committee of the whole.

Motion carried.

Dr. Conrad. I would like to add a vote of thanks from the Fourth International Dental Congress to Dr. Corydon Palmer, for his presence at this meeting as the oldest dentist in the United States.

Dr. Crawford. I move that this be accepted, and that the resolution be made a part of the minutes of the congress.

Motion carried.

Dr. C. W. Rodgers, Boston, Mass. Another part of this congress it seems to me has been very successful, and that is our exhibits. I would like to incorporate in the resolution a vote of thanks to those who have attended to this part of our congress.

The President. Without objection that will be included.

There was no objection.

Dr. Conrad. I would like to add a vote of thanks to Dr. B. Holly Smith for his very efficient services as chairman of the general reception committee.

Dr. Crawford. The omission of that must have been an unintentional oversight; I would like to add thereto thanks also for his services at the banquet at the Jefferson Hotel.

Dr. CONRAD. I would like to add also a vote of thanks from the Fourth International Dental Congress to the commissioners of the Missouri State Building at the fair grounds for their courtesy in lending their building for the reception we had there August 29th.

Dr. CRAWFORD. I hope that will be ordered also.

There was no objection.

Dr. EMMA E. CHASE, St. Louis, Mo. Has any mention been made of the beautiful exhibit of instruments that Dr. Sauvez brought over? I should like to have a vote of thanks extended to him for this exhibit.

Dr. CRAWFORD. I move that that be included in the report.

Motion carried.

Dr. CONRAD. I would like to have the Fourth International Dental Congress by a rising vote thank Dr. Palmer for his presence here.

Dr. KIRK. I would second that motion.

Motion carried.

Dr. A. W. HARLAN, New York, N. Y. I would like to make one further addition. This is the first time the United States government has seen fit to appoint official delegates to a dental congress in the United States, and I would like to have an appropriate recognition of that sent to the proper department to show our appreciation of the interest that the government has taken in this congress.

There was no objection, and the amendment was ordered to be duly incorporated in the report.

The PRESIDENT. The gentleman who has just come upon the stage has done a great deal of very valuable work as chairman of the Committee on State and Local Organizations, and I have great pleasure in introducing to you Dr. J. A. Libbey of Pittsburg.

Dr. J. A. LIBBEY, Pittsburg, Pa. Two or three of the gentlemen here said that they have not prepared any speech. Well, I have; I have been preparing a speech for this occasion for two years, but I am not going to give it all to you. Two years ago I was placed in a position to be in a measure responsible for the appointment of the organization committee for this congress, and I want to say that if I never did anything else in the profession, I shall at least congratulate myself for that. I have followed the work of this organization committee from its inception. I have attended every meeting of the committee except two, and never in all my experience of nearly thirty years in work in the dental profession have I seen as thorough work done in such harmony, as was done by that committee. But it is not necessary that I should say anything more of the organization committee. The work of the committee is shown by its results, and I congratulate the members, each and every one, for the successful consummation of their efforts. I have heard some members complimented for having the burden of this work thrown upon their shoulders, but I know of no one man on that committee who has worked harder than another; every man has done his duty and has done it thoroughly. I want you to know, when I am saying this, I am not a member of the committee. I was appointed chairman of the committee on conference with state and local societies; that meant the general information bureau of the organization committee of the congress, the soliciting of memberships, securing donations from state and local societies, making all decisions as to the reputability of those applying for membership. We had a little work to do in that capacity, and I want to say that I never before had anything to do with a body of nearly fifty men that worked in such harmony; they made my work as chairman of the committee easy, and they contributed largely to the results that we have seen here this week. I desire to personally thank each one of the committee on state and local organizations. The suggestion which has been made, that we keep that committee as a permanent organization is a good one, so that when any national question comes up, or there is any national work to be done, or any member of the profession wants to know anything in reference to any particular state, territory, or possession, there will be someone who is thoroughly posted and who can either give or find the information desired. This should be done in order to keep in touch with the profession all over our country and to be ready to assist in any movement that may be made for the advancement of the dental profession. I want to thank you one and all for the kindness and assistance you have given to all the workers in this great congress, and I hope five years from now, when we go over across the water to the next congress, we shall have even a greater meeting than this one.

The PRESIDENT. As you all well know, it is a good thing to have a full treasury. We have had a most efficient officer as chairman of the finance committee; he has rendered great service, and I now ask Dr. C. S. Butler of Buffalo to say a word.

Dr. CHAS. S. BUTLER, Buffalo, N. Y. It is scarcely fitting for me in the closing moments of this congress to detain you with even a single remark, and yet there are some things which I can say and say better perhaps than anyone else, as I am the only person in possession of all the facts.

There are a few facts in connection with the congress which I think it will be pleasant for you to carry away with you. In the first place we have a very large enrollment of members, exceeding when all are counted, sixteen hundred. There are members registered from every state, territory and province of the United States, excepting only Alaska and Puerto Rico. There are members registered also from twenty-eight foreign countries. But there is one feature in connection with our membership which is a source of very great regret and sadness to me, relating to one foreign country. I refer to Russia, which has registered in the congress three members, no one of whom I believe is present. I received a letter from the chairman, Dr. O. Klingelhoefer of St. Petersburg, about ten days ago, conveying to me the very sad intelligence that none of the Russians would be permitted to attend the congress, as they had all been drafted into the service of their country as hospital stewards. I think some expression of regret from the congress should be conveyed to these members in far away St. Petersburg.

One fact which I think will be gratifying to you all is this, that although it is the largest and probably the most expensive congress yet held, we have the satisfaction of knowing that we have in the treasury funds sufficient to pay all expenses and I trust have a very nice balance left over.

A word or two relative to the Transactions. It will require a year to prepare, print, and distribute the proceedings of the congress, so do not get impatient. They will be delivered to you in September 1905, if the contract for their publication is carried out, and we have no doubt that it will be. The Transactions are yours; you have paid for them in your membership fee and they will be delivered to you at the address which I have in your enrollment, so you may feel perfectly at ease regarding them; and when the great volume of the output of this congress comes to you I think you will realize as never before the magnitude as well as the value of the Fourth International Dental Congress.

In closing, permit me to thank you most sincerely for the extreme courtesies you have shown me personally in every particular and sometimes under somewhat trying circumstances, and I wish to express my deep regret that owing to my official duties I have not been able to attend any of the section meetings; but the expressions of appreciation and approval that have come to me from every direction, particularly from our foreign members, lead me to believe that the untiring efforts of the organization committee and sub-committees having in charge the work of organizing and carrying through this great enterprise have been crowned with unqualified success, and if this shall be your verdict upon a more mature deliberation personally I shall feel amply rewarded for any deprivation I have sustained in being deprived of the pleasure and profit of attending the regular sessions.

Dr. A. H. THOMPSON, Topeka, Kans. In regard to our Russian *confrères*, as Dr. Butler has suggested, I move you, Mr. President, that our sympathies be extended to our Russian *confrères* and members of this congress in their and their country's misfortunes, and that our sincere regret be expressed to them that they have been unable to attend this our Fourth International Dental Congress.

The motion was unanimously carried.

The PRESIDENT. I am sure you will all agree with me that one of the most successful features of the congress was the section on Clinics; and I wish to present at this time the chairman of the clinic committee, Dr. J. P. Gray of Nashville, Tenn.

Dr. J. P. GRAY, Nashville, Tenn. Gentlemen, if the clinics have been a success—and I believe they have been—it is owing to the aid that I have received from the gentlemen selected to help me, Drs. McFadden, Hinman, and Root, who gave me valuable assistance and did the work so far as the obtaining of clinicians is concerned. I want especially to mention some of the gentlemen in St. Louis who gave me much valuable aid. Without them it would have been an impossibility for us to have had the clinics, and those gentlemen I want to name here so that you may know who has given you the magnificent arrangements for the clinics; they are Drs. LeCron, Bassett, Haverstick, Summa, Boyd and Williams. We were sorry that we could not have given you a larger clinic, but we did not have room for more. We tried to make the clinic a varied one and we feel we have succeeded in that respect. I want here to publicly express my thanks to every clinician, those who gave clinics and those who could not come. We thank you, Mr. President, for the expression of appreciation you have shown us in the resolutions.

The PRESIDENT. I take pleasure in presenting to you Dr. G. V. I. Brown of Milwaukee.

Dr. G. V. I. **BROWN**, Milwaukee, Wis. Mr. President, I thank you for this opportunity to express my appreciation of the kindness of those who placed me in charge of the section of oral surgery. I desire to thank also, although he is not present, Dr. Arthur Black, our secretary, for his able assistance; and further to recognize my indebtedness to the audiences which have patiently listened to papers and discussions under difficult conditions and who have thus helped the work of our section. I believe we have accomplished the purpose of that section in giving to the world some idea, at least, of what we really mean by oral surgery. I wish also at this moment to thank some of the gentlemen who are here from abroad who met me a little over a year ago in Madrid, Spain, and accepted my representations there with regard to this congress and its purposes as the statements of a gentleman, and, like the gentlemen that they are, gave me their hands in co-operation. Without them there could have been no international dental congress; they are here in simple good faith carrying out their portion of this great work. I feel a personal pride that all I said, believing in those who sent me, believing not only in their purposes but in their honesty and ability to carry out that which they undertook, has been fully verified, and it is a matter of great satisfaction to me at this time, for which I am truly grateful to know that my representations of what this congress would be, have been fully and more than fully justified by the work of the week which is just closing. I thank them all for their assistance in bringing this about, and I thank you again, Mr. President, for the opportunity to publicly make this acknowledgment.

The PRESIDENT. I now have the pleasure of presenting to you a distinguished gentleman from Georgia, in the person of Dr. Wm. Crenshaw, a member of the organization committee.

Dr. WM. **CRENSHAW**, Atlanta, Ga. I do not thank Dr. Burkhart for this exposure on this occasion. He knows I don't make speeches. But since I have been called upon, I will say that I am very pleased to be here, and very pleased to see the success of the efforts of these various committees and the various sections in this grand work. I feel that it constitutes one of the best and most successful efforts in the history of dentistry. I am sure that we all feel stimulated by what has transpired, and that hereafter the success of such undertakings in America will be made the more easy by the success of this one.

The PRESIDENT. I now present a member of the organization committee in the person of my old friend, Dr. J. W. David of Texas.

Dr. J. W. **DAVID**, Corsicana, Tex. I am not a speechmaker and I only want to say that I am a small man from the biggest state in the biggest country of the world; and I am the only man on the committee of fifteen who did not do a great deal of work and who does not deserve a great deal of credit, and I thank the President for the opportunity of making it known, so that I shall not have that burden on my conscience.

The PRESIDENT. It is with very much pleasure that I now present to you a gentleman who has not been heard very much as yet, in the person of Dr. Conrad of St. Louis.

Dr. William Conrad, St. Louis, Mo. The President has just admonished me not to talk long. I have been at it all week, and now I don't think I am able to talk either long or loud. But I wish to express my thanks to the officers and those present for this meeting. I am truly thankful for a successful ending. It has caused me many worried days and sleepless nights, but, thanks be to all, the end has come and success is the only thing that remains.

I wish to thank the organizing committee for the many courtesies they have extended to me, and especially do I wish to extend my thanks to the local reception committee of the state of Missouri for their kind co-operation and hearty support. I wish also to thank the members of the general reception committee and its chairman, Dr. B. Holly Smith of Baltimore, for their hearty support in giving the beautiful entertainment at the Missouri State Building. I want to thank the foreign delegates for the honor they have conferred on our St. Louis dentists by their presence, and for the dignity they have added to the congress. When men who represent the Fédération Dentaire Internationale come thousands of miles to be with us, we feel proud. Men like Godon and Sauvez of Paris, Aguilar of Madrid, Guerini of Naples, Miller of Berlin, Bryan of Basel, Jenkins of Dresden, Grevers of Amsterdam, Harlan of New York, and many other international dentists who helped in promoting our congress I feel truly we have had an international meeting. They have made this meeting one long to be remembered for its good work. The final reports will show that the Fourth International Dental Congress was the most successful professional congress held during the universal exposition. This opportunity the President has given me to express my thanks to you all is a very grateful moment to me. I truly thank you.

The President. Now I present one of the hardest workers on the organization committee, Dr. B. L. Thorpe.

Dr. B. L. Thorpe, St. Louis, Mo. My heart is filled with gratification at this moment, and I know I but speak the gratification of the entire membership of the reception and arrangement committee of Missouri when I tell you that we are pleased and delighted to have had this magnificent meeting in our city, and the opportunity of meeting these distinguished gentlemen from at home and abroad and bidding you welcome to our city. We all are proud of the achievements in the organization of this congress, and we know that the work of this congress will be lasting and beneficial. The friends we have met and the acquaintances we have made will long be pleasant memories with us. The meeting, I think all will say, from a social and from a professional standpoint has been a wonderful success. We are glad to have the venerable and well-known Dr. Palmer with us. It is also pleasing that we have had, as a member of this congress, a young lady practitioner of dentistry who is a great-granddaughter of the pioneer Horace H. Hayden. In behalf of the profession of St. Louis active in this congress, I thank each of you for the contributions you have made towards the success of this meeting, for the encouragement and the kind expressions you have given us. We hope that as you go forth from these walls this afternoon you will carry with you the most pleasant recollections of St. Louis and St. Louis dentists.

The PRESIDENT. I now take great pleasure in presenting to you the man who holds the keys of this congress, in the person of the treasurer-general, Dr. M. F. Finley.

Dr. M. F. FINLEY, Washington, D. C. *Mr. President and Members of the Fourth International Dental Congress:* It has never been my forte to make speeches; those who know me know that to be true. Unfortunately I did not have an opportunity to consult the man who has written the speeches for those who have preceded me, Dr. Gray. He said he had mine prepared, but failed to deliver it. I will simply say, therefore, I thank those who have placed me in these positions of honor—being a member of the organization committee and now having been elected your treasurer. As you well know, I am subject to orders; nothing comes forth from that receptacle of money except on due order. And as I ascended this platform I received an order to make my speech short: that will be done; it would have been done without orders. This is one of the happiest moments of my life, one of the happiest occasions—to have been a humble worker toward the success of this great congress. I thank you.

The PRESIDENT. I now present to you a distinguished gentleman, formerly of Chicago, now of New York, Dr. A. W. Harlan.

Dr. A. W. HARLAN, New York, N. Y. I am very glad to be able to say a parting word. One of the works that has been accomplished by this congress is that of perpetuating the International Dental Federation for a second period. It was born in the city of Paris at the close of the third congress, and it has now passed through the teething period, and we hope that during the five years that shall intervene between this and the Fifth International Dental Congress it will make a still greater impression on the mind and thought of the world that is associated with this profession. I thank you.

The PRESIDENT. We have all been honored by having with us at this time at this congress one of the most distinguished practitioners in the world, a gentleman who has always had the best interests of dentistry at heart and who has spent many years in doing great work on the continent, and not only the continent of Europe but for dentistry throughout the world. He has received all the honors which the profession can confer upon him, and yet there was an additional honor conferred in making for him the place of honorary president of the International Dental Federation; and I am sure you will all applaud the members of the council for creating that position and electing our distinguished guest, Dr. Charles Godon, as that honorary president.

Dr. CHARLES GODON, Paris, France. *Mr. President, ladies and gentlemen:* I am very proud of the honor that was conferred upon me by my *confrères* in this great movement. We have come from afar, and we can say that we have not lost our time. In this very successful congress we have seen, done, and worked much. We have seen in your clinics the best clinicians of the world, and have heard in your sections the best papers. I am pleased that I came here. I came not only to see dental work, but to bring you word as to our new organization that we call the Fédération Dentaire Internationale. I am very grateful to see that our distinguished *confrères* visiting in this country have received these attentions. Also I came here as a delegate not only of our dental school and association, but of our public authorities for the care of the teeth of the poor, and I was pleased to see that you adopted one of our resolutions as to complete dentistry instead of emergency dentistry for the poor. We must work not only for the benefit of dentistry, but also for the benefit of the public. I must thank you, gentlemen, for the support you have given to our dental federation by placing it upon a stable and continuing basis.

The PRESIDENT. I take pleasure in presenting the treasurer of the International Dental Federation, Dr. Florestan Aguilar of Madrid, Spain.

Dr. FLORESTAN AGUILAR, Madrid, Spain. *Ladies and gentlemen:* I have been unexpectedly called upon to speak. Few are to be my words—words of gratitude and words of thanks to the organizers of this congress. Charmed with the success of the Fourth International Dental Congress, I have only words of praise for the grand work that has been performed. Its magnitude has not been fully appreciated yet. We will see and appreciate it better when the Transactions of this congress have been published. We will see then the good that has been done for the advancement of dental science, which work we have not been able to appreciate fully because of the impossibility of being in all the different sections at the same time. So we must wait until we receive the Transactions which will contain a record of what has been done in *all* the departments of this congress. For that great work we must thank the organizers of this congress, who can feel the satisfaction produced by having accomplished something for humanity as well as for our profession. In the name of my country, and in the name of the many foreigners who have expressed to me these sentiments, I tender my heartiest thanks to the organizers and to the officers of this congress, and to all those who have worked so heartily for the grand success that has been attained.

The PRESIDENT. At the Columbian Congress a distinguished gentleman favored us with his presence; he made many friends then; he has retained them until now, and he goes away with the same old friends and many new ones: I ask you to give your attention to Dr. Zsigmondy.

Dr. OTTO ZSIGMONDY, Vienna, Austria. I am not an orator, nor am I a master of English, but I want to speak my deepest, my heartfelt thanks for the kind reception I have had in this country and especially in St. Louis. I am not able to express myself in the right words; I can only say I thank you gentlemen, each and all, who have done so much to promote this magnificent congress to such a success. I think I may express my feelings in the best way when I say that I found all my wishes fulfilled—all my expectations. The wish that was left was that I could multiply myself so as to be present in the different sections at one time; that was impossible. I feel very thankful to you, but I cannot express myself in the proper words. I thank you.

The PRESIDENT. You will all be glad to hear a word from a gentleman who is so well known to all of you, Dr. Jenkins of Dresden.

Dr. N. S. JENKINS, Dresden, Germany. As the representative of a society of dentists practicing in Germany who have received the greater portion of their education in America, I beg to congratulate you upon the happy issue of the important work of this great international congress. And in the name of all my German colleagues I beg to thank you for having given to Germany the distinction of being the place where the next international congress shall assemble. I promise you that we shall accord at that congress not only a hearty welcome to you all but an enthusiastic welcome, and that we shall offer to you the best products of our hands and brains, and that above all we shall try to advance the cause of binding together all the ethical members of our great and beneficent profession throughout the world in the bonds of a common brotherhood.

The PRESIDENT. I now take pleasure in presenting to you another distinguished gentleman from abroad, Dr. Guerini of Italy.

Dr. VINCENZO GUERINI, Naples, Italy. I shall not try your patience with my bad English. I will say only that the few days I have remained among you have been days full of real happiness. I hope to see you in Italy—many of you—and when that time shall come, certainly I shall then take upon myself the pleasant task of reciprocating the welcome that I have received from you here. I shall then also show you in what way I am now grateful to you.

The PRESIDENT. I now present to you a gentleman from Switzerland, Dr. L. C. Bryan.

Dr. L. C. BRYAN, Basle, Switzerland. Being also a delegate from the same society which Dr. Jenkins represents in Germany, as well as of my own state, where I am practising, I beg to concur fully in the remarks of Dr. Jenkins and to promise you as a member of that society a most hearty welcome in Germany when you meet there at the time specified for the next international congress.

The PRESIDENT. I now have the pleasure of presenting to you the secretary-general of the International Dental Federation as well as of the Fourth International Dental Congress, Dr. Kirk of Philadelphia.

Dr. E. C. KIRK, Philadelphia, Pa. To all of these expressions of appreciation I wish to add my hearty indorsement and to express my personal sense of gratitude to everyone, to every individual, for the uplift which this congress gives to the profession that we all love.

The PRESIDENT. I now present to you from the South, Dr. J. Y. Crawford of Nashville, Tenn.

Dr. J. Y. CRAWFORD, Nashville, Tenn. This to me is a most solemn occasion. I have worked long for the success of dental surgery, and I am deeply gratified at the result of this congress in the way of advancing the science of dental surgery. In my enthusiasm I may have manifested too much interest on some occasions, but, like the Roman orator, who said, in speaking in extenuation of an offense perpetrated by one of her citizens in slaying another, it was not that he loved Brutus less but that he loved Rome more—if I have said too much in favor of the South, it is not because I have loved the North, the East or the West less, but I have loved the South more.

The PRESIDENT. It only remains for me to thank you most profoundly for the honour which has come to me as your presiding officer, and for the uniform courtesy which I have received at your hands. I may also say that while I have presided over a number of bodies before, I have never had the distinction of presiding over one that was more obedient to the rulings of the chair. I feel grateful to you for your many manifestations of friendship. To our distinguished guests from abroad I desire to extend our most hearty thanks for their presence and for the prominent places which they have filled in the work of this congress. I desire also to thank the profession in St. Louis for their assistance to the organization committee, and to all of you who have come here and manifested your interest in this great congress and contributed so much towards its success. I say, I thank you from the bottom of my heart. I say, thank you on behalf of the dental profession in America. It only remains now for me to say good-by and good wishes to all of you, and to declare this congress now adjourned to meet in Berlin, Germany, in 1909, as the guests of the Central Verein Deutscher Zahnärzte, that meeting to be called the Fifth International Dental Congress.

Adjourned.

Fourth International Dental Congress.

(*A*)—SCIENCE.

(*SECTIONS I—IV.*)

SECTION I.

SECTION I:

Anatomy, Physiology, Histology, and Microscopy.

Chairman—Dr. M. H. Cryer, Philadelphia, Pa.
Secretary—Dr. W. C. P. Hough, Sydney, Australia.

FIRST DAY—Monday, August 29th.

The section was called to order on Monday, August 29, 1904, at 2 P.M., by the chairman, Dr. M. H. Cryer, who read the following address:

Chairman's Address.

Gentlemen of Section I: It gives me much pleasure to welcome the members of this section of the Fourth International Dental Congress, and to express my great appreciation of the honor of presiding over so representative a body of men. While our section, from its purely scientific nature, may not attract very large numbers, we are more than compensated by the high quality of the papers which have been prepared for us by men whose achievements entitle them to speak with authority upon their special work.

We have reason to feel encouraged over most of the work within the province of our section. During the past few years much new and valuable information has been brought to the attention of the dental profession concerning the anatomy, histology, and microscopy of the oral cavity and the parts directly associated with it. In the branch of physiology I feel that the dental profession has a wide and promising field for scientific research. In most of our colleges physiology is taught by medical men, and the latest books upon the subject are written by medical men. It is to be deplored that more of the chairs are not filled by men who have given special consideration to the physiology of the mouth, as the general physiologist cannot give to it the attention it justly deserves. There is little doubt that investigations on the oral cavity from a physiological standpoint would be of the highest value to dentistry and to the race at large.

The prime object in a thorough knowledge of anatomy, histology, and physiology is the better understanding of pathology. Without a thorough knowledge of these, neither medical nor surgical treatment can be judiciously carried on. A vast improvement in the method of teaching anatomy has been brought about through the minute sectionizing of the cadaver and the introduction of the Roentgen rays with their revelations of the internal structures in the living subject. Special and general surgeons are no longer satisfied with the old stereotyped lectures and text-books on the subject; these and the old, irregular dissecting-room methods have become antiquated since the surgeon has found so large a proportion of his mistakes due to the non-practical knowledge he obtained in his college.

In the region of the head and face the work of Zuckerkandl of Leipzig (in 1893), Dr. A. Quodi of Budapest (in 1895), Turner of Scotland, and Frazer of Ireland, have done much in bringing to light facts which were before hidden. The rhinologists of America have also done considerable sectionizing of this region, demonstrating the relations of the orbit, the ear, and the throat to the oral cavity.

Comparison of notes among laryngologists, otologists, rhinologists, and dentists, showing the essential correspondence of the results of this kind of dissecting in their various lines, brought these various men together for consultation. It is no longer uncommon to see dentists taking part in medical societies and to have medical men reading and discussing papers before our dental meetings. The program for this section contains the names of men who have become famous not only in their own profession but in the medical profession generally, and whose names are indelibly registered among those of investigators.

In what might be termed dental anthropology, the dentist has contributed important ideas upon the shapes and forms of the teeth of the races of men in the past as well as the present. He has also done much in the study of the face in its aberrations from the forms that might be termed typical through the various phases of deformities arising from degeneracy.

In histology and microscopy we have the work of Miller of Berlin and Leon Williams of London, and the fine contributions of Caush of Brighton and others —all of the greatest value and reflecting much credit upon the dental profession.

As our profession becomes older it will inevitably grow more scientific in its trend of thought. With the higher standards thus created our department of its work will attract a relatively large number of the men who will devote themselves to original research, which in turn will aid the practical dentist in the betterment of his practice and the more scientific working out of his methods.

When every department of dentistry feels the quickening impulse to better, more thorough work, we may look for the highest perfection of dental service. The theoretical acting upon the practical will suggest improvement, the practical will confirm the theoretical, and scientific dentistry will be the result. To the end that this much to be desired goal may be reached the sooner, it is to my mind desirable that the intending student shall have a broad education on general lines. Then it would seem that four years would be little enough to acquire the practical mechanics of dentistry and the thorough drilling in anatomy, histology, chemistry, physiology, bacteriology, and pathology —in their general and in their special aspects—which I conceive to be necessary to fit a man to properly grapple with the diversified problems of practice.

In closing, I wish to present to this section a message from my dear friend and preceptor, Prof. Thos. C. Stellwagen, who is unable to attend the congress, and for whose opinion we all have the greatest respect. It is as follows: "I beg you to remember me to the many true men who are struggling so valiantly and so successfully for the elevation of our beloved profession. Say to them for me, that as the scouts of an army should have the means of observation and judgment to appreciate the force of the enemy, so the dentist must be educated and capable to diagnose diseases that so frequently find entrance to the general system and also leave their foot-prints upon it through the oral tissues."

Discussion.

Dr. Florestan Aguilar, Madrid, Spain. We have had the pleasure of hearing the brilliant address of Dr. Cryer. Any words of praise that I might use concerning him would be inadequate to express the sentiments of admiration that I have for my professor, whom we all know to be one of the benefactors of the dental profession, and not only of that profession but of the medical profession at large. His beautiful anatomical work has been reported in the proceedings of various dental and medical societies. I do not know if it be in order to discuss the present address, but as I am temporarily occupying the chair I will take the liberty of asking if any gentleman wishes to make any remarks on the address. If not Dr. Cryer will resume the chair.

The Chairman then called on Dr. Florestan Aguilar, Madrid, Spain, to read his paper, as follows:

Somnoform: Its Physiological Action and Its Administration.

By FLORESTAN AGUILAR, D.D.S., *Madrid, Spain.*

Everything tending to the alleviation of pain is of such importance to those devoted to the practice of dentistry that we observe with a marked degree of interest anything pertaining to the fields of general and local anesthesia. The discovery of Dr. Rolland, director of the Dental School of Bordeaux, of the mixture which he has named *somnoform,* and which consists of ethyl chlorid 60 per cent., methyl chlorid 35 per cent., and ethyl bromid 5 per cent., I consider to be one of the most important clinical discoveries of modern times. At the congress of the Association Française pour l'Avancement des Sciences held in 1901, Dr. Rolland presented for the first time an essay on somnoform, accompanied by clinical demonstrations. Since then its use has been largely generalized in Europe, where over 25,000 patients have been anesthetized by Dr. Rolland himself. These cases, together with others recorded at the hospitals of England

and France and in the medical department of the University of Madrid, constitute a total of over 100,000 cases in which the properties of this anesthetic have been tried.

A series of 100,000 favorable cases confirms without doubt the satisfactory laboratory experiments previously carried out, showing conclusively the advantages of this agent over chloroform and nitrous oxid, from the minimum of danger incurred by its administration when employed for brief anesthesia.

Upon the brilliant studies undertaken by Dr. Rolland, and the writer's own experience and investigations in the laboratory of physiology of the University of Madrid, the notes have been prepared which I now have the honor of submitting to your consideration and discussion.

In order that an anesthetic should enter the respiratory tract and act on the nerve centers, it must be in the gaseous form; and the rapidity of its absorption is in direct ratio to its degree of diffusibility. This is the force which causes the blood corpuscles to become saturated with the narcotic vapors instead of with oxygen; therefore the action of the gas on the nervous system will be rapid in proportion to the rapidity of saturation. Dr. Rolland presents the problem of anesthesia in the following propositions:

First: To produce anesthesia it is necessary that the tension of the anesthetic gas be superior to that of oxygen, so that it may in a certain proportion, take the place of the latter in the pulmonary alveoli.

Second: The tension of a gas being proportionate to its volatility, the more volatile the gas is, the easier can it be made to take the place of oxygen.

Third: The ideal anesthetic, if such be attainable, would be the one behaving in its conditions of entry, of sojourn, and of exit from the body, as does oxygen.

If we follow the course of oxygen in the body, we see that the red blood corpuscles, after becoming charged with oxygen in the lungs during inhalation, distribute it to the tissue throughout the body. The blood corpuscles have their period of activity during their course through the arterial system. When the oxygen has been given up, the corpuscles return through the venous system to the lungs in an inert and dormant state; and there by contact with oxygen resume again their former activity. Now, as about twenty-five or thirty seconds are necessary for a red corpuscle after leaving the heart to return to it, we can say that in this diagrammatic division of the circulation in two parts, one arterial and the other venous, the action of the oxygen would last from twelve to fifteen seconds; therefore an anesthetic capable of being absorbed practically in the same manner as oxygen should produce its effect in about fifteen seconds, and when the administration is discontinued it should be eliminated in proportion, as the corpuscles of the blood come again into contact with the oxygen. This, almost to exact precision, is what takes place with somnoform. In the study of this physiological action we observe that somnoform produces the following phenomena.

THE CIRCULATION.

Somnoform has a powerful action on the sympathetic system, increasing the arterial tension and the frequency of the cardiac contractions. A series of curves of the blood tension taken with the sphygmograph of Marey and the sphygmomanometer of Potain on the radial artery of Dr. Rolland showed in twenty minutes a variation of from 13½ of normal blood pressure to 14½, 17, 17, 13, 14, 15, 14, 14, 13½, during, through, and after the anesthesia. The pulse, which formerly was 76 per minute, presented in the same observation a frequency of 76, 84, 76, 68, 68. Respiration, which when normal was 16 per minute, went up to 28, 20, 19, 20, 20. And a careful microscopical study of the blood of subjects under somnoform showed that the anesthesia of from five to eighteen minutes' duration produced no important modifications in the blood. The urine of the anesthetized persons also remained normal.

THE NERVOUS SYSTEM.

Microscopical studies of the cerebral centers show the modifications produced by somnoform on the neuron. The neuron, as is well known, is the anatomical nerve element, or the nerve cell and its branches, as discovered and investigated by Ramón y Cajal of Madrid, and is composed of three parts: first, a central part which is the real cell, with its protoplasma containing elements with and without peculiar affinity for coloring matter, and its nucleus. Second, a peripheral part made up of protoplasmic branches and the various ramifications (dendrites), with ends which do not anastomose; and third, the more peripheral part formed by the axis cylinders, which do anastomose.

THE CEREBRUM AND CEREBELLUM.

The investigations were made on the cerebrum and cerebellum of rabbits and cats: first, on non-anesthetized animals (control subjects); second, on the animal at the end of an anesthesia varying from five to fifteen or twenty minutes; third, on animals at the end of a prolonged anesthesia (one hour or more); and fourth, on the animals one hour after consciousness had returned.

The staining of tissue was made by the rapid method of Ramón y Cajal of Madrid, and by the method of vital staining of Ehrlich by the intravascular injection of Gubler's methylene blue.

In the right carotid artery of the animal experimented upon, injections were made every five minutes of from 2 to 10 cc. (or according to the size of the animal) of methylene blue. At the end of a half-hour the brain-case was opened and microscope sections were obtained. The researches were always controlled on non-anesthetized animals.

The changes brought about in the neuron by somnoform differ in the various regions of the cerebrum and cerebellum, also in accordance with the duration of the anesthesia.

FIRST SERIES: SHORT ANESTHESIA.

Cerebral covering. The pyramidal cells with their branches remained normal; they did not change in size. The chromophile granulations of the protoplasm could be clearly seen; the nuclei were normal.

Cerebellar covering. The methods of Golgi and Nissl show the sharp modifications undergone by the cells of Purkinje, a slight deformation and irregularity of shape. The protoplasmic prolongations were varicose. It appears that from the beginning of anesthesia the mixture has a particular action on the nerve elements of the cerebellar covering.

SECOND SERIES: DEEP AND LONG ANESTHESIA.

In this series of experiments the guinea-pigs died at the end of a quarter of an hour or after twenty minutes. Cats, as well as rabbits, resist for several hours. Where fragments of the nerve centers have been removed from the living animal, or from an animal which has just died, the results obtained by examination are the same, and the modifications are as clear in the cerebral as in the cerebellar covering.

Cerebrum.—The cells diminish in volume. The protoplasm presents excessively clear zones, and the protoplasmic branches remain intact.

Cerebellar covering.—The modifications of the cells of Purkinje are very marked. The protoplasmic branches are deformed and present varicosities and knots.

THIRD SERIES: ONE HOUR AFTER RECOVERY.

There was return of all the elements to their normal state excepting the cells of Purkinje, which are slower to regain their normal form.

Speaking of these experiments, Dr. Rolland concludes as follows: "Somnoform has an elective action on the cells of Purkinje, thus suppressing sensitivity to pain and temperature—its passage through the cerebellum; and when there is saturation or excess of the anesthesia the pyramidal cells are impressed, determining loss of consciousness." It only remains to state that the results of this observation show that the minimum of danger is incurred in the administration of somnoform, which during a short operation causes sleep without in any way acting on the cerebral covering. This selective power on the part of certain substances for a definite portion of the nervous system should not be surprising to us. We know, for instance, that chloroform, ether, and alcohol have in their action a preference for the cerebral covering; that cocain in moderate doses acts on the peripheral endings of sensory nerves; that strychnin shows a preference for the cellular elements of the anterior columns of the spinal cord; that nicotin paralyzes the nerve cells of the sympathetic ganglia; that curare acts on the motor nerve endings. These experiments show conclusively that somnoform acts first on the cerebellum and secondarily on the cerebrum.

CLINICAL STUDY.

Somnoform, as is the case with any other anesthetic, determines in the patient three well-defined states: First, pre-anesthetic period, or that of induction. Second, anesthetic period, or that of resolution. Third, post-anesthetic period, or that of elimination or return to consciousness.

In each one of these periods we observe two types of phenomena, subjective and objective.

The subjective phenomena in the first period are emotional: a feeling of anxiety, of suffocation, blurred vision, tinnitus aurium, light tickling in the extremities, and the strange sensation of having a warm compress on the cerebrum from the occipital to the frontal lobes.

In the second period, or that of true anesthesia, the patient experiences no sensation whatever.

The third or post-anesthetic period commences by a sensation of far-away buzzing, the reappearance of the sense of hearing, dreams of different types, gay, religious, amorous, professional, etc., generally in relation to the subject of which the patient was thinking immediately before the anesthesia. At first he fails to recognize the place and the persons that surround him, this state being followed by return of motion, with a tickling in the extremities.

Clinical classing of cases. Clinically we can group the patients into three classes as follows:

The first class—embracing 90 per cent. of all cases—is constituted of those patients who are tranquil and unresisting. With a dose of from 3 to 5 cc., in from fifteen to thirty seconds they are anesthetized, and they remain so for from fifty to seventy seconds and sometimes for nearly two minutes. When they regain consciousness they are pleased, and express satisfaction and wonder at the slight amount of inconvenience they have experienced.

The second class will be more difficult to anesthetize. It comprises the restless class of patients who involuntarily resist anesthesia. When the administration begins they fight to get the mask off the face; they swallow but do not breathe, at first; sometimes they cry out, but finally lapse into unconsciousness. These patients are found in the proportion of 8 or 9 per cent.

The third class of patients is constituted of the alcoholic, epileptic, hysterical, and tobacco users. They are difficult to anesthetize, and the elimination of the anesthetic takes place slowly. They are irritable and the anesthetic seems to have on them a hysterogenic action, provoking a nervous crisis. Fortunately, patients of this kind will be found only in a proportion of about 1 per cent.

METHOD OF ADMINISTERING SOMNOFORM.

Always employ a mask or inhaler in preference to a handkerchief or waterproof cone, with which it was originally applied. The inhaler will permit, not only the exact measurement of the dose employed, but also rapid induction by reason of the total exclusion of air—a factor of great importance. After seating the patient with the head in line with the body, explain that deep inhalations should be taken, that the liquid has a slightly irritating odor, and that it will produce a quiet and agreeable sleep, particularly if he can induce himself to think of something pleasant. The pneumatic pad of the inhaler having been inflated and tried on the patient's face, pour the somnoform from the bottle into the chamber of the inhaler in the dose of 5 cc., or the contents of a capsule; close the chamber very rapidly, and instantly apply the face-piece. Generally in about twenty seconds the action of the agent will begin and the signs of general anesthesia will be evident—namely, cessation of the ocular movements, drooping of the eyelids, dilatation of the pupils, complete relaxation, occasionally rigidity of the arms, and loss of corneal reflex. The induction is complete in from thirty to forty-five seconds, and the anesthesia lasts from sixty to ninety seconds. The pulse slightly increases in frequency and tension, and the color of the face remains completely normal without trace of the cyanosis that appears when nitrous oxid is employed. When recovery of the patient begins, analgesia persists during some seconds, allowing a little more time to operate with the patient in a semi-conscious state. In four or five minutes the patient completely recovers.

In conclusion, I consider somnoform the most valuable general anesthetic in dental practice, from the rapidity of its induction (thirty seconds) and the length of available anesthesia (fifty seconds), from the possibility of administering it to all patients and without special preparation, from its pleasant effects, and from its safety, demonstrated not only by the investigations on its action on the nerve centers, but also by a clean record of over 100,000 cases.

I may add, gentlemen, that I have here the mask that I have been employing in my practice, and also another mask that, since my arrival in America, I have found is manufactured in this country. As soon as the clinics are organized, tomorrow or the next day, I intend to give a clinical demonstration.

I have brought a patient here this afternoon whom, if the president will allow me, I will anesthetize, so that you can see how quietly the effects of somnoform are produced, and the rapidity with which anesthesia is induced by it. I have used it many hundreds of times in the clinic of the dental department of the University of Madrid. As I say in my paper, Dr. Rolland has a record of over 25,000 cases operated upon by him, and there are additional hospital records in France, England, and Spain, besides private cases, which sum up over 100,000 in all.

The manufacturers prepare somnoform either in little glass capsules like this one which I have here, or in large flasks. These little capsules are convenient, because each contains an exact amount and there is no danger of administering too large an amount. The face-piece contains a piece of cotton which absorbs the required amount of somnoform. This can be charged every time a patient is operated on. The pipe is very smooth, and can be washed and made aseptic.

Now, the way in which I proceed in my practice is, as stated in my paper, first to explain to the patient that the liquid has a slight pungent odor, that he should be quiet and confident and should think of something pleasant. I have observed that if at the moment one applies the face-piece reference is made to music, as, "Do you not think you are hearing some nice music; do you not think it is beautiful?" it overcomes the repugnance of the patient, and when he recovers consciousness he has recollections of a musical dream.

Dr. Aguilar then administered the anesthetic to one of the persons present. The total time taken up by the operation was announced as having been three minutes and twenty seconds; the time required to produce the anesthesia, twenty-nine seconds; the duration eighty seconds, while the period of partial consciousness lasted to between eighty and ninety seconds.

Discussion.

The CHAIRMAN. Gentlemen, you have heard this very interesting paper and have witnessed the demonstration by Dr. Aguilar. It is a method that has not been used, I believe, in this country so much as in France, England, Spain, and Italy. My observation while in Europe last year was that it was quite commonly administered. In the Philadelphia Hospital it is being used to a certain extent. The paper is now open for discussion.

Dr. MORRISON. I would like to ask Dr. Aguilar in what cases is the administration of somnoform absolutely contraindicated.

Dr. SUBIRANA (whose remarks were made in Spanish and were translated by Dr. Aguilar as follows):

Dr. Subirana says that he can speak from the viewpoint of both patient and operator. While at Bordeaux he had occasion to be anesthetized by Dr. Rolland; and while under the influence of somnoform had his hands pierced with a pin and felt absolutely nothing. He was afterward operated on, and he declared himself entirely satisfied. As an operator in Madrid he has recently used somnoform very frequently in his practice with the best results. He insists on the importance of the proper technique in administration. He states that at first he had some failures, but was convinced that they occurred because air was permitted to mix with the anesthetic vapor. He has also used it in connection with chloroform in general surgery, and cites a case which occurred not many days ago where he assisted a surgeon at a hospital, giving at first somnoform and finishing with chloroform, in order to prevent the period of excitement produced by chloroform. By thus commencing with somnoform he obtained much more rapid anesthesia. He says he got one of the physicians to administer somnoform to him. The physician undoubtedly gave him an overdose, and he says that he was dizzy and sick. He thinks this was due exclusively to the excess of somnoform administered to him and to the imperfection of the administration.

Dr. LOSADA. I may add something to what has been said in the discussion of somnoform. I myself have been anesthetized with somnoform half a dozen times at the very least. I find the action of somnoform very similar to that of nitrous oxid; these two are very much alike in their effects. I find this advantage in somnoform, that the technique is much simpler, because you do not have to carry a big gas outfit. As Dr. Subirana says, if you take an overdose of somnoform—and I have been given an overdose twice, I believe—you do not feel at all well afterward; just as when you take an overdose of gas you do not feel at all well.

Dr. Aguilar has had more practice in the use of somnoform than I have, but my experience has led me to believe that somnoform does not seem to act well on some people. In some cases there is not always a complete loss of consciousness. There is partial anesthesia, but still the patient has some idea that he is alive. In spite of this fact, however, I believe somnoform to be a very useful anesthetic for extractions and minor oral operations. The trouble with all these general anesthetics for me is that their action is very rapid, and sometimes when you have to extract two or more roots it does not give you the time necessary to carry out the operation. That is why in most of my cases I prefer local anesthesia, which does not frighten the patient—at least never so much as does general anesthesia, the effects of which are usually disagreeable.

A MEMBER. It seems to me that this anesthetic has some advantages over gas. The period of anesthesia is a little longer, and there is the advantage of not having a bulky apparatus; and then, too, it appeared to have an analgesic effect after the profound anesthesia had passed. I wanted to ask Dr. Aguilar if it was practicable to use it to obtund sensitive dentin in order to prepare a cavity without causing too severe pain.

Dr. GRIFFITHS. I would like to ask Dr. Aguilar whether it would be safe in cases of difficult extraction of roots, when the operation cannot be completed before consciousness returns, to re-administer somnoform at the same sitting.

Dr. MATTHEWS. I should like to ask Dr. Aguilar to state the external symptoms of somnoform anesthesia, the effect on the pupil, on respiration, and on the pulse.

Dr. LOSADA. They are the same as in any kind of anesthesia.

Dr. AGUILAR (closing the discussion). In answer to the remarks made by Dr. Subirana I can only say that I agree with him as to the importance of properly administering the anesthetic. It is very important to exclude all air when once the inhalation has begun. If a perfect occlusion of the apparatus with the face be not made, a very imperfect anesthesia will result and a much larger amount comparatively of the anesthetic, and a longer time, will be required to produce unconsciousness. Therefore, with Dr. Subirana, I likewise insist upon the importance of a total exclusion of air during the administration of the gas. I may also say that it is true, as he has stated, that you can produce a very agreeable chloroform or ether anesthesia by beginning with somnoform, overcoming in this way the excitement period of ether or chloroform anesthesia.

In regard to the remarks made by Dr. Losada, I may say that I have not found that some patients cannot be anesthetized with somnoform. If you will recollect, I said in my paper that there are alcoholics and epileptics who manifest a resistance to the action of somnoform, and upon whom it produces an hysterical effect. That is, it provokes a nervous crisis, just the same as in the case of chloroform or nitrous oxid. You have all doubtless found in the administration of nitrous oxid that some patients exhibit a state of violent excitement. Happily I find the proportion of that class of patients in my practice to be only about one per cent. I have made these computations after consultation with Dr. Rolland, whom I saw before I came here. He also stated that in his experience, covering 25,000 administrations only, about one per cent. of the patients are very difficult to anesthetize with somnoform.

Dr. Griffiths has asked if it be possible to re-administer the anesthetic; that is to say, in the case of several extractions, if the patient returns to consciousness before the operation has been completed. I have done that on several occasions without any bad after-effects.

In regard to the question as to which were the cases in which I considered somnoform anesthesia contra-indicated, I may say, in very marked valvular disorder only.

I may also say that one of the best advantages of somnoform is that it produces absolutely no change in the appearance of the face, which remains perfectly normal.

SECTION I—Continued.

SECOND DAY—Tuesday, August 30th.

The section was called to order at 2.30 P.M., by the chairman, Dr. M. H. Cryer.

Dr. Alton Howard Thompson of Topeka, Kans., read the following paper:

Ethnographic Odontography: The Mound-builders and Pre-Indian Peoples of the Mississippi Valley.

By ALTON HOWARD THOMPSON, D.D.S., Topeka, Kans.

When the first white emigrants crossed the mountain barriers on the east and entered the great valley drained by the Mississippi river and its tributaries, they were astonished to find everywhere throughout this region the remains of an ancient people. There were mounds and tumuli; military earthworks in the form of circles, squares, circumvallations; effigy mounds in simulation of animals, stone graves, altars and religious symbols, temple mounds with terraces and graded ways, walls and roadways, and other structures that were imperishable, that attested the presence of a people far removed from the savage state and well on the road to civilization and culture.

Having long since passed away and left no records, they became known—for want of a better name and on account of utter ignorance of who they were and whence they came—as the "Mound-builders," because of the marvelous and extensive earthworks they erected throughout the length and breadth of the Mississippi valley. And we know little more of this wonderful people today. Who they were and whence they came is still one of the unsolved puzzles of American archæology. They were presumably of the great American race that the European discoverers found here, and they were probably more or less related to the historic Indian, some tribes of which may be descended from them. But that the marvelous structures were erected by the tribes found by the whites in this region —as is maintained by some writers—is quite impossible; for these tribes had nothing and knew nothing of the civilization of the mound-builders. Some of the historic Indians did, it is true, erect mounds as tumuli, but they were incapable of the elaborate structures which the ancient race left, for instance in Ohio and Wisconsin, and were as ignorant of the origin and purpose of the mounds and earthworks as the white settlers who followed them. About the only thing that we are sure of is that these remains were the work of a prehistoric race of Indians whose identity we cannot make out, but who were in an advanced stage of barbarism—they were not mere savages for they were skilled in architecture, in pottery, metal work, and other branches of art and industry which were of a standard of excellence such as mere savages like the historic Indians were incapable of.

The writer is inclined to the theory advocated by J. D. Baldwin ("Ancient American," page 70), that the mound-builders were emigrants from Mexico and were possibly the descendants of the Toltecs, that semi-mythical race whose culture the conquering and fierce Aztecs adopted as the basis of the wonderful civilization of the Mexican valley. This hypothesis explains many things in connection with the mound-builders. Baldwin says, "Their most populous settlements were in the south; this was the only coast entrance to the valley: they pushed up the Mississippi river and its tributaries: their architectural structures and their art is similar to that of Mexico and Central America: the great mounds—like the Cakokia mound near St. Louis—are like the temple teocallis of Mexico and Yucatan," etc.

To this evidence the writer would add that of dental somatology, which is similar to that of the Mexican tribes in many features. This will be noted later.

Many writers have touched on the theory of the Mexican origin of the mound-builders, which to the writer seems the most plausible. The art, as for instance the designs on the shell carvings and pottery, are decidedly Mexican in character. Some of the figures are exact reproductions of figures found in Mexico and Central America—and surely evidence could not be more conclusive.

But, whoever they were, they are gone—swept away by the savage tribes who were the ancestors of the Indians whom the whites found in the country. That they were much superior to the tribes who destroyed them is abundantly proved by their remains. The latter were a nomadic and hunting people, while the mound-builders were settled in towns and lived mainly by agriculture. They were probably a gentle people, like their ancestors the Toltecs of Mexico, unwarlike in their character and devoted to cultivating the soil, to architecture, to art, and to the pursuits of peace. They were vastly different from their savage conquerors in every characteristic, and that the latter could have been even the degenerate descendants of the mound-builders is quite impossible. They evidently invaded the Mississippi valley from the south; divided into different branches as they went; developed different characteristics of architecture and art in different parts of the region; erected great structures that remain to our day, lived their lives, were driven out, and died and left no record.

The groups of mound-people selected for investigation are restricted, of course, but may be taken as fairly typical and representative of the entire pre-Indian population of the Mississippi valley, varied and extensive as these were. They were probably all of one stock, and were derived from the original emigrants from Mexico. These gradually separated into groups and pushed on into various parts of the country and developed different customs and characteristics by isolation for long periods of time. If there be any general distinction to be made, it would better be in regard to age, for the deposits of some groups are undoubtedly older than others, and the older tribes were probably driven out or absorbed or exterminated by later comers. That is common with primitive people, and the overlapping waves with their consequent intermingling of stocks lead to much confusion. However, in the case of the pre-Indian peoples of the Mississippi valley, the mound-builders and others, it is likely that the special groups selected were distinct and unmixed, and are therefore to be relied upon as sufficiently pure for our investigations.

The main groups selected as furnishing the best and most reliable material were as follows: That from the prehistoric cemetery at Madisonville, Ohio, in the American Museum of Natural History of New York, and in the Peabody Museum of Archæology and Ethnology at Harvard University; the Fox farm stone graves of Kentucky, in the American Museum; the Lyons collection from Edmonston county, Kentucky, in the Peabody Museum; the stone grave collection of Tennessee, in the Peabody Museum; and the collection from the mounds of St. Francis river, Ark., in the Peabody Museum. These were the principal groups examined, but to the skulls from these places must be added smaller lots of skulls and single skulls from other mounds and deposits, making about five hundred in all which were tabulated. The smaller groups were from Saginaw and Detroit, Mich., miscellaneous skulls from Ohio, Kentucky, Tennessee, Missouri, and other states.*

The broadest general characteristic with which the writer was impressed in investigating the jaws and teeth of the pre-Indian peoples of the Mississippi valley was in a large sense their essentially primitive nature. This was somewhat surprising, when considering the advance in the elements of civilization and culture that their remains indicate. The comparison was quite remarkable, and if it teach us anything it would be that their evolution in cultural attainments must have been rapid, as sufficient time had not elapsed for the degenerative effects of the vices of civilization to affect their physical organization. Perhaps, again, their civilization might not have advanced to the stage of producing degradation by its vices, but remained at a healthy and normal condition for a long period. Certainly the primitive characteristics of the dental structures are not what we should expect in association with the high degree of civilization which their remains indicate. For instance, there is pronounced prognathism of the jaws as a prevalent feature. This is quite in contrast with the jaws of their Mexican ancestors, which are quite orthognathous, indicating their advance in degenerative evolution while the mound-builders remained at the primitive stage. The jaws were also strong and large and the arch prominent. The teeth generally presented many primitive features, and were yet very irregular and degenerate in different and surprising directions.

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* The writer desires to acknowledge his obligations to the various museums which furnished the material for this investigation, especially to the American Museum of Natural History of New York and the Peabody Museum of Harvard University, which supplied the most, and for the assistance furnished and the uniform courtesy of the officials. Also for material and uniform kindness to extend thanks also to the Academy of Natural Sciences, the Museum of Art and Archæology of the University of Pennsylvania, and the College of Physicians and Surgeons, of Philadelphia, Pa., to the Field Museum of Chicago, the Historical Society of Tennessee at Nashville, the Missouri Historical Society at St. Louis, and others who rendered valuable assistance.

One of the most impressive of these features was the great frequency of the fifth tubercle on the lower second molar. This was quite remarkable when the other molars were less well developed and some of them quite degenerate. Many other primitive features occurred in an irregular way throughout the groups. On the whole, the teeth presented many primitive features but were quite irregular as to their occurrence.

DISEASES.

As regards the prevalence of dental diseases, many indications were observed, but not to the extent that dental lesions were found among the Peruvians and Mexicans. Caries was present in all groups to some degree, but remarkably absent in some, as in the Saginaw mounds, which are evidently very old. In the Madisonville group caries was very prevalent, with all of its usual complications, abscess, etc. In the Fox farm and Edmonston groups of Kentucky it was also very prevalent. In the stone grave people of Tennessee and the St. Francis river, Ark., groups it was more notably absent. Mechanical abrasion was variable, being extensive in some groups and less so in others, but the wear of mastication was light for so primitive a people. This might mean that they were not a maize-eating people, for we know the silica of the kernel is very destructive, as evinced by corn-eating tribes. The Peruvians had much destructive wear of the teeth, due to this food and to coca-chewing. Very little salivary calculus was observed and large deposits were notably absent. An occasional case of transverse erosion was observed, but pitting or other congenital effects of disease were absent. Taken altogether, there was not much dental disease present as compared with the Peruvians and Mexicans, as noted in previous papers.

Supernumerary teeth, deformities, cingules, etc., were quite unusual. Third incisors and bicuspids and fourth molars were rare, but were sometimes present. The fourth molar fused to the third occurred, but was rare. The peg-shaped upper third molar occurred, and sometimes the peg upper lateral, but both were rare. The suppressed upper lateral was also rare. The lingual cingule upon the upper molars or incisors was very rare. These reversions were surprisingly infrequent considering the general primitive nature of the denture of these people.

Irregularity and malposition of the teeth was very interesting on account of its frequency among these people. The deformities due to malposition were not extensive or complicated, but there was frequent occurrence of eversions, rotations, slight divergence from the line of the arch, or complete misplacement as regards the alignment and occlusion. The most common forms were such as a lower incisor standing within or without the line: the eversion of the upper centrals at the median line: rotating of the upper laterals and lapping: the canines standing out of the line in the well-known "tusk" form: the bicuspids crowded in or out of the arch: the tipping of the third molars so as to impact them, etc. The latter was very frequent. Of these slight deformities there was a considerable amount, considering the large size of the jaws and the apparent room. There were very few, scarcely any, contracted and saddle-shaped arches. The deviations from normality of arrangement were quite similar to those of the Mexicans as to types, as we should expect, except that they were mostly quite simple and not as extensive as the latter.

SKULL FORMS.

The cephalic contours and indices of the pre-Indian tribes were most interesting, as they presented types that were quite constant within groups. In general the forms were decidedly brachycephalic and high, and long skulls were very infrequent. There was considerable occipito-frontal flattening, the usual cradle-board effect. This was especially common in the Kentucky stone graves but was found elsewhere to some extent. The long skulls were not sufficiently frequent to constitute a class, and were evidently intruders. Many of the round skulls were prognathous, with all of the long skulls, of course. Indeed, prognathism was found generally among these people as a primitive feature. The parietals were usually bulging, but the valley between the parietals was not marked.

The skulls from the Saginaw group of mounds were very old and friable. They were very large, and were round and high with retreating forehead. In characteristics and condition they gave every evidence of being very ancient, and there is every probability that they belong to a period anterior to that of the Mexican emigrants who built the mounds and tumuli.

In the Madisonville cemetery they were generally quite round and high, and usually small. They ranged in size below medium. The few large skulls usually had the full bulging occiput and the high sagittal ridge. There was very little flattening observed in this group, and as this was slight it may have been due to earth pressure. The very bulging parietals were probably normal though the flattened skulls had more of this prominence than the others.

The miscellaneous skulls from the mounds of Ohio were of the same character, *i.e.* round, high, full parietals and some few flattened.

The skulls from the Fox farm group in Kentucky were, as a rule, round and high with full parietals. There was a large proportion of occipito-frontal flattening with consequent bulging of the parietals. The majority seem to have been flattened as if the custom was very common in this group.

The skulls from the Edmonston county, Ky., group were, as a rule, small, and were round and high. The large ones were round but with the bulging occiput. There was some flattening, but not so much as in the previous group.

Those from the stone graves of Tennessee were large, round and high, and strong and very coarse as compared with the small, light skulls of the previous groups. The majority were very large and very few small ones were observed. There was much flattening with corresponding bulging of the parietals. The median ridge was usually quite prominent. A very few were long with bulging occiput, and some of the round skulls presented this feature also. The prevalent form was decidedly brachycephalic, which would indicate a pure blood stock in this group.

The small Natchez group were much flattened.

The large group of the St. Francis river mounds in Arkansas were very interesting. The skulls were medium in size, all round and high with markedly high, full parietals, even in the normal specimens. The sagittal ridge was markedly full in most of the specimens. There seemed to be little or no flattening, except from earth pressure. This would show a distinct culture as to customs from the stone grave people of Kentucky and Tennessee.

The Missouri mounds showed the usual form of large, round high skulls, with high sagittal ridge and some flattening.

The miscellaneous mound-builders' skulls from various parts of the Mississippi valley showed the same general type, but with a proportion of long skulls that were probably intrusive burials. These narrow specimens usually had the bulging occiput. There was some flattening, but not much, in these miscellaneous skulls.

The jaws, dental arch, and vault were especially interesting among these people, on account of the primitive features which they exhibited, which are quite remarkable for people so far advanced in the elements of culture and the arts. The most impressive of these primitive features was the prognathism that was almost constant, as it prevailed largely in almost every group, and, as it was associated with the prevailing brachycephalism, was very remarkable. The prognathism is quite at variance with their relatives in Mexico, who are quite decidedly orthognathous, with round arches and round heads. But in the pre-Indian peoples of the Mississippi valley we have the anomaly of prognathism with round heads. The contour of the arch was usually square, as an accompaniment of prognathism, but thin and inharmonious with the round head. The vault was usually quite deep also. Indeed, all of the general features were primitive to a surprising degree.

In the Saginaw group the jaws were very prognathous and the vault deep. The arch was usually square or round square. The width of the upper arch—measuring at the outside of the first molars—was 6 cm. to 5.5 cm., which is rather narrow for such large arches but not for the square type. This group being more ancient, of course the features are very primitive.

The Detroit group ranged in width from 6 cm. to 5.5 cm., the arch square and flaring at the back and the vault deep, and prognathous of course.

The Madisonville group presented a larger percentage of the round arches which were more in harmony with the round craniums. There was considerable prognathism, especially with the square arches, but less than in some other groups. A few round V-shaped arches were noted, but were probably abnormal. The vault was unusually deep and square, very few shallow roofs being noted. In measurement—from the outside of the upper first molars—the width of the arch ranged from 6 cm. to 5.5 cm., a very few being below 6 cm. and some up to 7 cm., but not many; the average was 6.3 cm., which is quite large. The Mexicans ranged from 6 cm. to 5.5 cm., so the average of these jaws is high.

The miscellaneous skulls from the Ohio mounds presented much the same characteristics as regards the jaws and arch, except that there is more uniformity. There was a general average of 6 cm. to 6.5 cm. in width.

The Fox farm, Ky., mounds presented a majority of the large round arches with converging at the rear, and an occasional round V arch; a very few were abnormal and contracted. The average width was 6 cm., ranging to 6.5 cm. Some were down to 5.5 cm., and a few were very large, running up to 7 cm. and even over; the latter are remarkably large. While there was great variety, the shapes were nearly all round with very few square arches. Prognathism was very prevalent, the majority even of the round jaws being very prognathous. Some of the very round arches were orthognathous.

The vaults were usually very deep, but a few flat roofs were noted in the small arches. The constancy of type was quite interesting.

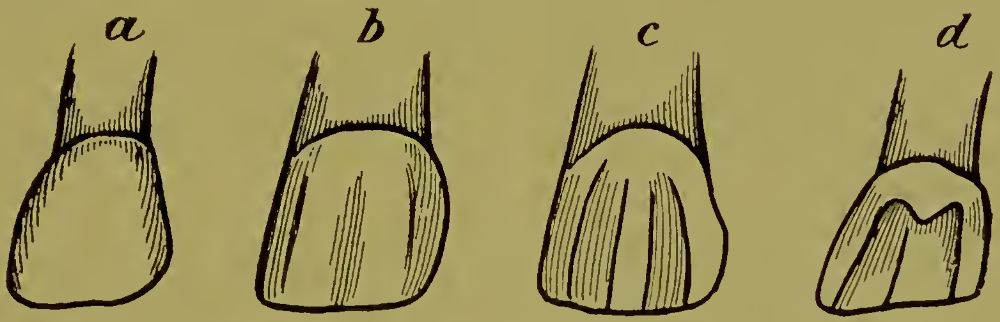
The Edmonston county, Ky., stone graves presented a large proportion of round arches with a good number of round V's. Very few square arches were noted, the prevailing type being round with converging ends. In width the average was near 6 cm., although a large number were below that, running to 5.5 cm., and even down to 5 cm., which is quite small. The vaults averaged deep, and prognathism was constant even with the small round arches with delicate craniums.

The Tennessee stone grave skulls were characterized by very large round arches with both flaring and converging ends. There were some round V's. The alveolus was thick and the general features were very primitive. The vault was deep and square in most cases. The average width was 6 cm., with a very few below or above. This constancy would again indicate, as in the case of the skulls, that these people were comparatively pure in stock, with of course some later intrusions. Prognathism was of course prevalent in all forms of arch, but especially in the few square arches and the round V's. The features are all quite primitive and remarkably uniform in this group. The St. Francis river, Ark., group were interesting on account of their uniformity, there being a prevalence of the large round flaring arch. There were a few square and some round V arches. The average width was 6 cm., with very few above or below. The vault was usually medium deep and prognathism was prevalent, but not so pronounced as in the previous group.

The Missouri mounds averaged larger and stronger, being round and round V, with an average width of 6.5 cm., which is quite high. Prognathism prevailed and the general structure was coarse and primitive.

The miscellaneous specimens from various other states did not present great variety beyond the average of the distinct groups catalogued. There was the same round arch or round V, the average width of 6 cm. or 6.5 cm., and the deep vault and prognathism. The features were generally primitive and uniform with those of the large groups.

FIG. 1.



Upper centrals of Mound-builders. *a.* Narrow neck. *b.* Wide neck. *c.* Ridges on labial face. *d.* Ridges on lingual face.

The upper central incisor, as with most of the other teeth, presented features that were both primitive and advanced. The principal varieties were the wide crown and wide neck and the wide lower crown and narrow neck. (Fig. 1.) These types were well marked, and the primitive wide neck prevailed in some groups. The wide lower half of crown and narrow neck is more advanced and is that which is most prevalent in the more developed tribes of Mexico.

In the Saginaw group the central was of medium size but much worn, as these skulls were very ancient, and the features were primitive.

In the Madisonville group the prevailing type was that the centrals were large, long, and square to the edge, with flat face, narrow neck, and with a deep lingual fossa and high ridges. The narrow neck with wide lower crown is not primitive. The face was usually flat with no indication of the primitive labial ridges, so the type in this group was advanced.

The miscellaneous Ohio mounds exhibited much the same features—the wide lower crown, narrow neck, and flat face. There was usually a well-marked lingual fossa with high ridges, which is a primitive feature.

In the Fox farm, Ky., group the central was usually large, with wide face to neck, wide neck, and round to edge. Some specimens measured 1 cm. to 1.3 cm. in width, which is very remarkable. The face was flat and long and square in outline. These are very primitive and ape-like and well marked. A very few had the more advanced type of wide lower half and narrow neck, but the majority had the wide, primitive neck, which was quite uniform and constant in the group. Labial ridges were also present in some of the more primitive specimens. This is an early and ape-like feature.

The Edmonston county, Ky., group of stone graves presented some of the lower wide face tapering to a narrow neck. A few were of the wide crown and wide neck type, but not many. The other features were not so primitive as in the previous group.

The Tennessee stone grave group, as was to be expected, had more of the primitive type of the wide crown and wide neck. Some of the crowns were 1 cm. in width, and one or two even over that. The deep fossa and high lingual ridges were also well marked. All the features were primitive and uniform in this relatively pure group.

In the Natchez group the type was narrow neck and wide lower half of the crown—not so primitive as we would expect.

In the St. Francis river, Ark., group the type of the upper central was wide lower half, tapering rapidly to narrow neck, although some had wide neck with slight labial ridges. The lingual fossa and ridges were not so conspicuous as in some other groups.

In the Missouri mounds the prevailing type was wide lower half and narrow neck.

The miscellaneous mounds of other states generally presented much the same types and were not so primitive as some of the distinct groups.

The upper lateral incisors were similar to the centrals with which they were associated, but seemed to have in a general way more tendency to quite wide edges and very narrow necks with deep lingual fossa and high ridges. There were a very few deficient, peg-shaped crowns, and but one or two cases of total suppression, in the hundreds examined. There was not much tendency to wide necks even when the centrals were of this type.

In the Madisonville group the laterals were generally large with wide necks like the centrals; many, however, were wide at the edges and narrow necks. The labial face was generally more rounded than the centrals, and the rounding of the distal corner was usually very marked. Cingules on the lingual basal ridges were not numerous. A very few degenerate, peg-shaped crowns were observed, and even slightly deficient crowns were rare. Very rarely was the defect of the groove passing over the basal ridge on the neck on to the lingual face observed.

The Fox farm, Ky., group presented the type of wide edges but narrow necks, deep lingual fossa and high ridges, which was quite prevalent; there was little variation from it.

The Edmonston county, Ky., group had the type of lateral having quite wide edge with narrow neck, flat face, etc. A very few were deficient to the extreme of peg-shape.

The Tennessee stone graves exhibited some with wide edges and narrow necks and round face, and many others had thick necks like the centrals in this group. The lingual fossa and high ridges were well marked.

The St. Francis river, Ark., group presented the type of flat face, wide edge, and narrow neck, but a number were wide-necked also. But few were peg-shaped or deficient.

The resemblance to these of the Mexicans is apparent, but some of the special features are absent. On the whole the laterals exhibited great simplicity and uniformity as to general outlines and characteristics.

The lower incisors were of the usual simple form with little deviation except as to the comparative width of the central and lateral. In the most primitive types they are of the same width with no distinguishable difference except as to the roundness of the distal corner of the lateral incisor. In the more advanced races the central is narrower than the lateral, and the latter flares at the distal side. In the lower races the central flares as much as the lateral. As a rule, in all the large groups of the pre-Indian peoples—the Madisonville, Fox farm and Edmonston, Ky., the Tennessee stone graves, and the St. Francis river—the centrals were strong and long with quite wide edges, often quite like the laterals in the coarser tribes. In the more refined skulls the central was quite narrow. The perfection of form was constant.

The upper canines presented some marked characteristics, some of which are quite primitive. (Fig. 2.) The primitive, spear-like form of the labial face was quite prevalent in some groups, but there was some deviation to the conical type also. These teeth were not very large in general, but this was probably due to the association and correlation with the round arches, which does not have as large and conspicuous canines as the square arches. Some few had well-marked ridges on the lingual face, but not many. The labial face was usually flat in the spear shape, but in the round variety the vertical eminence was quite conspicuous.

In the Madisonville group the spear shape was quite prevalent, with flaring mesial and distal margins and round face which is most usual. The conical form was rare. They were usually large with deep roots.

The miscellaneous Ohio mounds presented the same general spear shape with flat face.

In the Fox farm, Ky., group the canines were quite large and long, and the type was rather more conical with roundness and fulness of the labial face. There was an occasional flaring of the distal borders; but few were of the strongly marked spear shape of the previous group. The fulness of the labial face was quite a marked feature.

The Edmonston county, Ky., group had canines that were generally medium large, with full labial face, with some few that were more flaring with flat face and spear-shaped outlines.

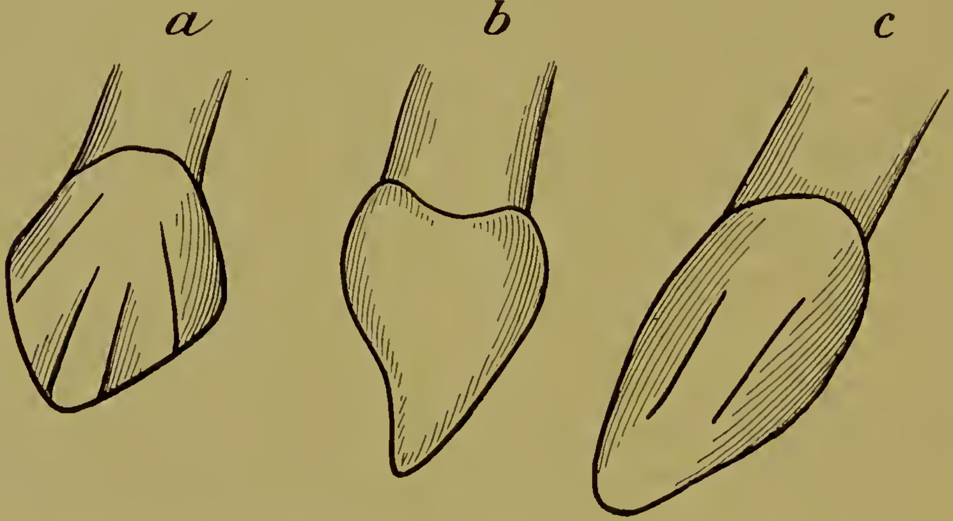
The Tennessee stone graves gave the type of medium to large in size—of round form but with flaring distal borders. The most were quite conical, and small. The type of canine was not so primitive as the other features would seem to indicate, as they were not very large nor coarse. There was more abrasion in this group than in some others, so the general features were somewhat obliterated, but the crowns were long with thick necks.

In the St. Francis river, Ark., group, they were medium to large, and were more generally of the spear shape with flat face. There were many of the round type with full labial face also, but the conical type was not prominent. The apparent reduction of the canine in all of these people was in probable harmony with the round arch in which this tooth is always reduced.

The Missouri mounds presented the type mainly of the large spear shape with flaring sides and flat face, with a few conical round forms also.

The miscellaneous mounds in other states furnished great variety, both the conical and spear shape being found without any uniformity as to type. Among the Mexicans the same general types were found, the prevalent smallness of the canines being in harmony with the prevalent round arch also.

Fig. 2.



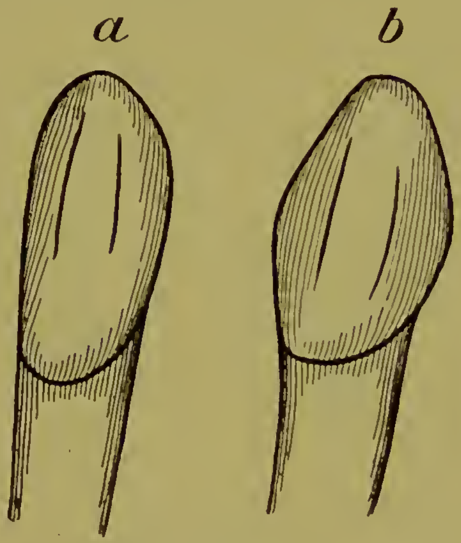
Upper cuspids. *a.* Spear-shaped crown. *b.* Mesial view. *c.* Conical form.

The lower canines among the mound-builders and pre-Indian tribes of the Mississippi valley were also of two general shapes, *i.e.* the flaring leaf shape, in which the crown had a vertical median face but flared greatly at the distal border, with flat full labial face, and the long, conical shape with full labial face and sharp point. (Fig. 3.) These two types were mixed in all of the groups, so that there was little uniformity, one being more prevalent than the other in some groups. In size they were small to medium, of course, like the uppers. The lingual ridges were not marked, as this is a primitive feature and these teeth were reduced.

In the Saginaw and Detroit groups they were rather small and usually flaring at the distal. The conical form was not conspicuous in these peoples.

In the Madisonville group the lower canines were small to medium and the conical form predominated, with comparatively few that flared distally. In the Turner group in the same locality they were quite large with full labial face.

FIG. 3.



Lower cuspids. *a.* Ordinary conical form. *b.* Spear-shaped form.

In the miscellaneous Ohio mounds the conical form predominated, the crown being long and pointed.

In the Fox farm, Ky., group, these teeth were quite large, coarse, and conical. There were very few that flared to the rear.

In the Edmonston county, Ky., group they were more flaring and wide at the distal side than the previous group. There were but few that were fully conical.

In the Tennessee stone grave people these teeth were large, and as a rule quite wide and flaring, with quite a full labial eminence. There were few of the conical type. They were rather small as compared with the primitive features of this group.

In the Natchez mounds they were large and conical.

The St. Francis river, Ark., group were medium to large, and averaged conical in shape, which was the prevalent type, although there were some few with flaring distal border and straight labial face.

In the Missouri mounds they ranged large and conical, but with full buccal face. In the miscellaneous mounds the conical form also predominated to a degree.

The bicuspids presented some interesting general features and showed some relationship with the Mexican types, although the prevalent smallness of the latter was not observed to the same extent among these peoples. Some general resemblances were found, but they were not constant. Perhaps this was to be expected, for the Mexican type was probably evolved after the departure of the emigrants to the Mississippi valley, and then followed the increase of the physical degeneracy which took place in Mexico.

Be that as it may, the type of the bicuspids is very variable in the Mississippi valley, and ethnic features are difficult to make out.

The upper bicuspids were large, and were flat and primitive, in harmony with the general features of this ancient group. (Fig. 4.)

In the Detroit group they were medium, oval, and flat.

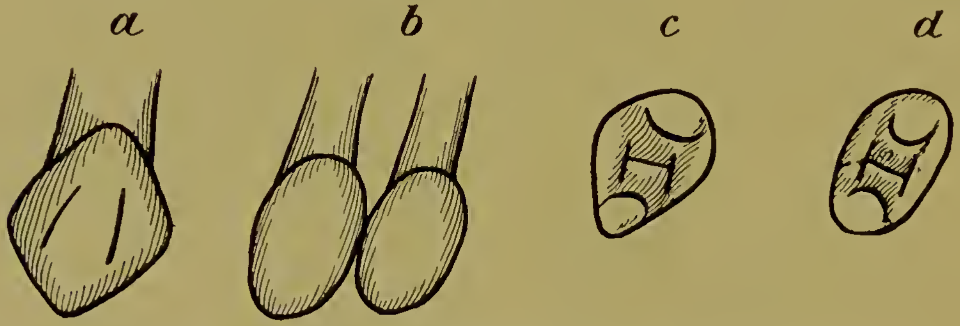
In the Madisonville group they were medium to large, quite short and flaring at the marginal ridges, and of the distinct pear shape that prevailed in Mexico, *i.e.* wide at the transverse mesio-distal diameter of the buccal side and very narrow at lingual side. This pear shape is quite conspicuous, although there were many of the flat and oval forms as well. The types were, in fact, very greatly mixed.

The Fox farm, Ky., group ranged from medium to small, some being very large and some very small. The types were confused also—oval, flat, and pear shape being generally found. Perhaps the large oval type predominated slightly.

In the Edmonston county, Ky., group the bicuspids were quite small and the pear shape was in the majority, the type being quite Mexican and would seem to indicate relationship.

In the Tennessee stone graves, the upper bicuspids were medium to large and of the Mexican pear shape, *i.e.* wide buccal and narrow lingual sides; often they were quite triangular, some of these being very small. The extreme specimens of this Mexican type were not common, however. Some had three roots, which is a simian reversion.

FIG. 4.



Upper bicuspids. *a.* Flaring form of buccal face. *b.* Oval form. *c.* Occlusal face, showing wide buccal cone and very narrow lingual. *d.* Oval form of occlusal face.

The St. Francis river, Ark., group were of the mixed types, but the small pear shape predominated, and it was quite like the prevalent Mexican form in its main features.

The Missouri mounds and the miscellaneous mounds were of the same general forms, with the pear shape predominating.

The second upper bicuspids were of the same general types as the first, except that they were as a rule smaller, some very small, and the main features were not so well marked. There was a larger proportion of the oval and flat forms, and not so many of the triangular and well-defined pear shapes as with the first. Taken altogether, the pear shape was well marked, however. Being smaller they recalled the Mexican type more than the first, but there were no peg-shaped crowns or real deformities on account of degeneracy, as with the Mexicans.

The lower bicuspids were in general smaller than the uppers, and the patterns of the occlusal faces were quite primitive. Like the Mexicans, they were quite degenerate as compared with the uppers, and had more of the relative smallness of crown.

The first lower bicuspids in the Saginaw group were small, with the lingual cusp in the second position, as a rule. (Fig. 5.)

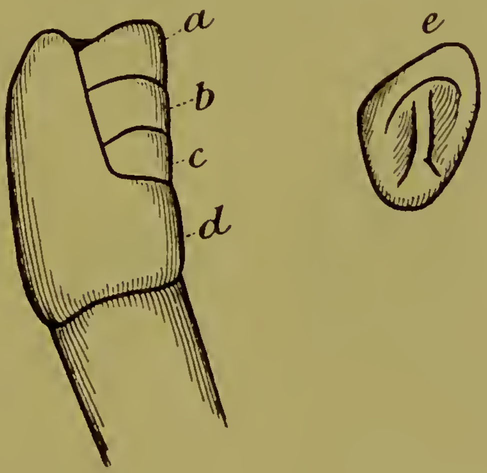
In the Madisonville group they were small and the lingual cusp was low, between the second and third positions, the buccal face being full, as usual. The position of the lingual cusp was affected more by deficiency and degeneracy of form than by evolutionary degeneracy, as with the Mexicans. The third position of the lingual cusp was not uncommon.

The miscellaneous Ohio mounds were much the same, except for the frequency of the fourth position of the lingual cusp, which is very primitive—an insectivorous feature, in fact.

In the Fox farm, Ky., group they were small with a large proportion of the third position of the lingual cusp, the second coming next in frequency, and then the fourth. The frequency of the lower positions was quite remarkable, and impressive as indicating primitive reversion.

The Edmonston county, Ky., group were quite small with the lingual cusp ranging from second to third positions, and occasionally fourth. A rare occurrence was the disto-lingual projection on the lingual marginal ridge. This unique feature occurs frequently with the Peru-

FIG. 5.



First lower bicuspid. *a.* First position of lingual cusp. *b.* Second position. *c.* Third position. *d.* Fourth position. *e.* Occlusal face, showing peculiar form of disto-lingual projection.

vians (it is distinctly an insectivorous reversion), and also to some extent with the Mexicans.

The Tennessee stone graves gave a majority of the third position of the lingual cusp, the second next, and then the fourth; this is quite primitive. The crowns were small with the full buccal face, in which they differed from the Mexicans, in whom the face of the deficient crowns was usually perpendicular.

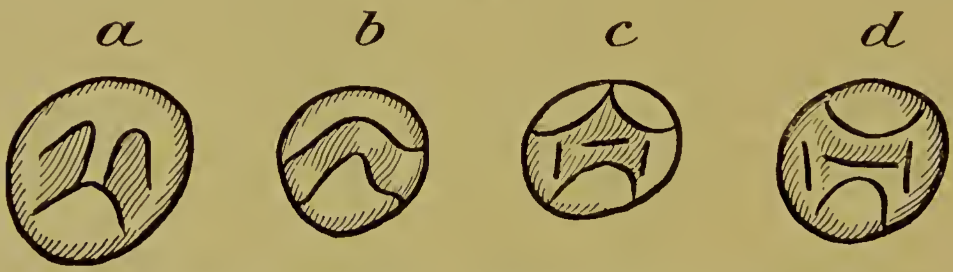
The St. Francis river, Ark., group gave these teeth in size medium to small, with the majority of the lingual cusps ranging from the third to the fourth position, with the second next. The prevalence of the low positions was very marked, indicating the predominance of the primitive types. The teeth in this group were lower in the evolutionary scale than those of the Mexicans.

In the Missouri and the miscellaneous mounds there was great variety of the position of the lingual cusp, but the majority were quite primitive, ranging from second to fourth. The size was usually small, below the average.

The lower second bicuspids are very interesting also on account of the evolutionary significance of the occlusal features. (Fig. 6.) As is well known, in the higher races, as Europeans, the tricuspid pattern of this surface is well marked, but in lower races this tooth has either a transverse ridge like the first bicuspid or has an undivided crescent cusp on the lingual marginal ridge. Therefore the three cusps become the reliable sign of the elevation of a race, *i.e.* they have more of the three-cusped type, and low races have more of the crescent and cross-ridge types. This rule is reliable and is of value in the study of the ethnology of the teeth. It was with great interest that we observed, therefore, that the low types predominated in the pre-Indian peoples, and that the three-cusped pattern was in the minority.

In the Saginaw and Detroit groups, for instance, the crescent and cross-ridge type prevailed, as we should have expected in these primitive peoples.

FIG. 6.



Second lower bicuspid—occlusal face. *a.* Transverse ridge form, like first bicuspid. *b.* Crescent form of lingual cusp. *c.* Tricuspid form. *d.* Bicuspid form.

In the Madisonville group these teeth were very small, with the crescent and cross ridge (in about equal proportion) in the great majority. The buccal face was full. Very few tricuspid crowns were observed, and a few full bicuspid. The crowns were short and flaring, *i.e.* wide at the marginal ridge and narrow at the neck.

The miscellaneous Ohio mounds were medium in size and with prevalence of the crescent form of the cusps.

The Fox farm, Ky., group presented the type that was small to medium, with predominance of the crescent and cross ridge in equal proportion. Tricuspid and partial tricuspid forms occurred a little more frequently than in the previous group.

A very few were of the type of the first bicuspid with depressed lingual cusp. This reversion is very rare and is distinctly insectivorous.

In the Edmonston county, Ky., group these teeth were small with cross ridge and crescent (in about equal proportion) predominating. A very few were tricuspid and still fewer were bicuspid like the upper bicuspids.

In the Tennessee stone grave people there was the same predominance of the cross ridge and crescent forms, with a very few tricuspid or partial tricuspid. The size was small to medium and the features were generally quite primitive in this group.

In the St. Francis river, Ky., group these teeth were quite small generally, with the same proportion of crescent and cross ridge types, with a few tricuspid and partial tricuspid types.

The Missouri and the miscellaneous mounds were about the same.

This uniformity of the proportion of the various patterns of the occlusal face of the lower second bicuspid, is something remarkable, and speaks volumes in favor of the low stage of these people. They were better developed than with the Mexicans who had these teeth very small and deficient, not full on the buccal face and almost cylindrical. With these people, however, the crowns were usually full and the buccal bulge prominent, but there was a less proportion of the tricuspid type than with the Mexicans, and more of the lower forms of the occlusal face.

The molar series of these people presented characteristics that were most interesting, yet also very perplexing and confusing. There were many primitive features presented, and yet with variations that were most remarkable and unaccountable. These we will not now attempt to explain, but only try to record them as observed. We must await further investigations to throw light on the remarkable variations found in the molars of these people.

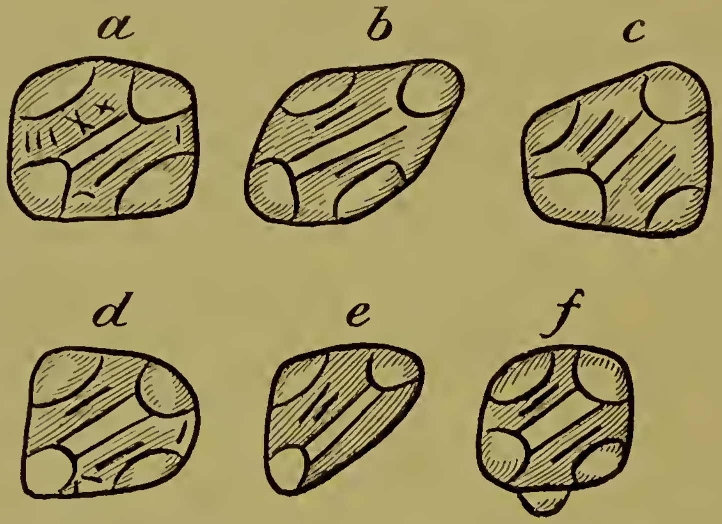
The upper first molar in the Saginaw group was surprisingly small for such an ancient and primitive people. (Fig. 7.) The form was not usually square, but rather trapezoid, owing to the depression of the metacone (the disto-buccal cusp). In the Detroit group the form was much the same.

In the Madisonville group these teeth were medium in size and exhibited great variability of the metacone. Some were trapezoidal with reduction of the metacone and the hypocone (the disto-lingual cusp), or again by the reduction of the protocone (the mesio-lingual cusp) and the paracone (the mesio-buccal cusp). Other forms were the diamond shape from the reduction of one pair of cusps and the enlargement of the others. Sometimes the hypocone was suppressed entirely, making a three-cusped molar, although this form was more frequent with the second molar. The large full, square type was quite in the minority. The smallness and variability of the upper first molars is most remarkable, for this tooth is usually quite constant and stable as to its form. The lingual groove was present in quite a number of the square and trapezoidal forms. This is a very primitive feature and leads back to the apes.

The miscellaneous mounds of Ohio presented a number that were large and square and well formed with the lingual groove, but a large proportion were trapezoidal.

In the Fox farm, Ky., group there was much variability of form and size, the most being medium to small. Perhaps the most prevalent was that of the trapezoidal, where the metacone and the hypocone (the disto-lingual cusp) were reduced. The slight reduction of the metacone was observed in all, even of the square crowns, of which there were a number, so that it begins to be possible that the reduction of the metacone may be a more or less constant feature of the upper first molar as the reduction of the hypocone is of the second. Some first molars that were not quite erupted in young skulls were square and quite wrinkled. A distinct diamond form was not unusual. The variability of the first molars in this group was quite remarkable.

Fig. 7.



First upper molar—occlusal face. *a.* Usual square, normal form. *b.* Diamond form, paracone and hypocone reduced. *c.* Trapezoidal form, paracone and protocone reduced. *d.* Trapezoidal form, metacone and hypocone reduced. *e.* Triangular form, hypocone entirely absent. *f.* Fifth cusp, hypoconule, added to protocone lobe.

In the Edmonston county, Ky., group they were large and of square and trapezoidal form, the metacone and hypocone being reduced in the usual trapezoidal type. The lingual groove was common. There was not as much variety here as in the previous group, as the types were more constant.

In the Tennessee stone graves they were medium to small in size, ranging from square to trapezoidal in form, with the lingual groove. The partial diamond form often occurred. A very few tricuspid forms occurred in which the hypocone was suppressed and the type of the second molar was produced. This is not common in the first molar. It reminded one of Professor Cope's theory of the lemurine reversion of the upper molars in man, as especially exemplified in the Latin races. The infrequency of the full type of the first molars is quite extraordinary, for they were very irregular as to form in all of these people.

In the St. Francis river, Ark., group

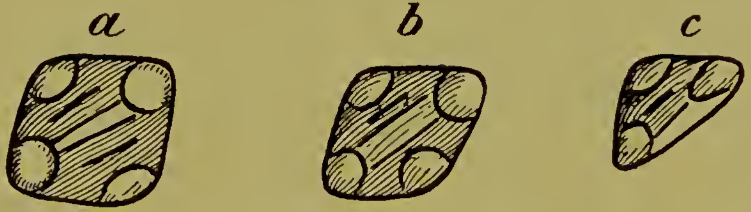
they were large, with the same trapezoidal type predominating. Some of the full square form occurred with the lingual groove, also with the wrinkled face, and again the diamond shape, but the latter irregularity was less frequent than in the previous groups. The low metacone was the one conspicuous feature that seemed constant.

In the Missouri mounds and the miscellaneous mounds of other states they ranged from large to medium and were square, trapezoid, and diamond shape in forms, but the full square type was uncommon, as with the rest.

In a general way the variability of the upper first molar among these people was most remarkable. The full square type was most rare, and yet this is a fairly constant and stable form. The meaning of these deviations is too difficult to read, so we must await the collection of further data before attempting to unravel the puzzle of their affinities and relationships, for among the Mexicans this tooth preserved its integrity of form very well, although most of the other molars were very variable. The collateral degeneracy of the entire molar series is not so noticeable as with the Mexicans—being in fact so very erratic. The metacone was reduced to a degree in some of the Mexican tribes, but not the other elements so much as with these pre-Indian peoples. Perhaps a chain of affinities might be followed out by more extensive investigations and tabulations. The field is most alluring and promising to the odontologist seeking fields that are new and unworked, and the results will undoubtedly throw light on obscure problems of American ethnology.

The upper second molar presents more uniformity than the first in being more reduced as a constant thing by the depression or absence of the hypocone. (Fig. 8.) The partial or entire suppression of this element produces the usual trapezoidal or tricuspid form of this tooth, which is quite constant in all races except the very lowest and ape-like, so that the full square form is quite rare in higher races that have any evolutionary advancement whatever. This is so constant as to have a diagnostic value in the placing of a race in the scale of evolution. So in these people this tooth was reduced as usual in the elevated races, and presented the ordinary form of the suppressed hypocone.

FIG. 8.



Upper second molar—occlusal face. *a.* Square form, like first. *b.* Hypocone reduced. *c.* Triangular form, hypocone entirely absent.

In the Saginaw and Detroit groups, this tooth was of large size and usually with trapezoidal form.

In the Madisonville group they were medium to small, trapezoidal and tricuspid in form, in irregular combinations. The hypocone was usually reduced or absent, the metacone not being so much depressed in this tooth. There was a large predominance of the tricuspid form in which the hypocone is suppressed entirely and the protocone enlarged to extend over the entire lingual face of the tooth, as is common in Europeans. The trapezoidal form was next in frequency, in which the hypocone is but partially suppressed and the metacone is depressed also. The trapezoidal form is often quite large and is accompanied by the lingual groove. Often the tooth on one side is trapezoidal and on the other is tricuspid, showing the erratic nature of these variations. Rarely there was a diamond form in this group also.

The full square form did not seem to occur in this group, so the evolutionary degeneracy was quite marked.

The miscellaneous Ohio mounds showed type medium to small and trapezoidal and tricuspid, the latter predominating.

In the Fox farm, Ky., group it was large to medium, and the form was medium and trapezoidal to tricuspid, the latter predominating. A very few were full square with hypocone and metacone in good form and with the lingual groove like the first. This perfection of form is very unusual.

In the Edmonston county, Ky., group the type was medium to small, trapezoid and tricuspid, the latter predominating. More diamond-shaped crowns occurred in this group than in the previous one, but the prevailing type was small tricuspid.

In the Tennessee stone graves the types ranged from medium to small and quite small, with the tricuspid form predominating and the trapezoid next. The tricuspid form was largely in the majority, which is interesting considering the very primitive types of some other features in this group. There were a few diamond-shaped, but no full square forms were observed.

In the St. Francis river, Ark., group the type was medium to small, trapezoid and tricuspid, the latter much predominating as usual, the regularity of which is quite remarkable in these peoples.

In the Missouri mounds they were quite large, tricuspid and trapezoid. A few were square and some few were diamond shape.

In the miscellaneous mounds the types were indefinite, ranging from full square to small trapezoid, the latter predominating.

The prevalence of the tricuspid type of the second upper molar among this people, who had so many other primitive features, is very remarkable.

It shows an irregular degeneracy, such as might have occurred before the beginning of a progressive degradation of physical structure which was harmonious all along the line. In the Mexicans this tooth presented more variety and the full type square form was not so unusual.

The lower first molar being the most constant in form and persistent in type of any teeth in the human denture, of course presented among these peoples the largest proportion of full typical forms. Very rarely was there loss of the fifth tubercle, like the second molar, or a division of a cusp to make a six-cusped tooth (which is not a type), or the mesial root was divided into two roots, but such variations were rare and did not affect the main type of the teeth.

In the Saginaw and Detroit groups this tooth was very large and flaring, with wide occlusal fossa and rearward elongation—which is a simian feature.

In the Madisonville group these teeth were large and flaring, with the simian elongation well marked. In some the fifth tubercle seemed to be reduced, but it was never absent. The occlusal fossa was usually wide, the triangular ridges not being well marked; this is also a simian feature. Rarely the cusps were high and sharp in the young skulls.

In the miscellaneous Ohio mounds the large and square form prevailed with wide fossa. Occasionally some were wrinkled, especially in young subjects. The reappearance of this orang feature so frequently in the molars of this people is quite interesting and remarkable.

In the Fox farm, Ky., group they were usually large and flaring, with wide fossa. The backward elongation was prevalent. Some were wrinkled. A very small number had the fifth tubercle divided, making a six-cusped tooth, and the divided mesial root was observed, but these irregularities are not types.

In the Edmonston group these molars were usually very large and flaring, with wide fossa and backward prolongation. The regular features were quite constant.

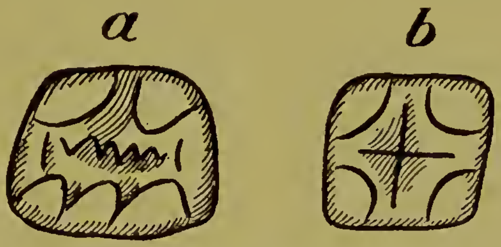
In the Tennessee stone graves these teeth were unusually large, with the wide fossa and simian projection quite conspicuous. The full primitive features were all well marked and constant.

In the St. Francis river, Ark., group they were large to medium, with wide fossa and projecting at the rear. Some few among the young skulls were wrinkled. The general forms were very constant as to the type.

In the Missouri and the miscellaneous mounds they were large and flaring, and the usual constancy prevailed.

The lower second molar is usually quadritubercular in the higher races, so it was to be expected that this type would be prevalent among these people. (Fig. 9.) In the lower races the fifth tubercle is found more frequently on account of their nearness to the apes. But one of the great surprises among these pre-Indian peoples who presented so much variety and evolutionary degeneracy of the dental features was the large proportion of fifth tubercles on the *second* lower molars. We should rather have expected the predominance of the quadritubercular form.

Fig. 9.



Lower second molar—occlusal face. *a*. Five-cusped form of normal first molar, found (as ancestral type) as a reversion in second molar. *b*. Degenerate but usual form of quadri-cuspid type of lower second molar in higher races.

In the Saginaw group, on account of these people being of ancient type, the fifth tubercle was in the great majority; very few of the four tubercles were found.

The crowns of the second molars were large and flaring and just like the first—owing to the fifth tubercle, of course, and the consequent enlargement of the crown. In the Detroit group the same proportion was also found.

In the Madisonville group the fifth tubercle was also very prominent—was indeed in the largest proportion, not one in four having the quadritubercular form. The crown was wide and flaring like the first, with the same wide fossa. This is a remarkable development of five tubercles in view of the variety and degradation of the other molars, some of which are usually so stable.

In the miscellaneous Ohio mounds the fifth tubercle was in about the same proportion. The crowns were of the same flaring form.

In the Fox farm, Ky., group this tooth was large and flaring, also with a preponderance of the fifth tubercle with wide fossa, the fourth being in the minority.

In the Edmonston, Ky., group there was the same proportion of the fifth tubercle and the large and flaring crowns like the first.

In the Tennessee stone graves they were of the same large flaring crown with the large proportion of the fifth tubercle with wide fossa. This was to be expected in this primitive group. There were very few of the cinquetubercular form, not a fourth.

In the St. Francis river, Ark., group there was a preponderance of the fifth tubercle with the flaring crown and wide fossa. But there were more of the quadritubercular form than in the previous group, and the primitive features were not so well marked.

In the Missouri mounds and those from the miscellaneous mounds from the other states the same proportion was observed, so that the general prevalence of the majority of the lower second molars having the fifth tubercle was quite impressive. This was not to be expected with peoples having so many of the stigmata of degeneracy in the other molars. It was most remarkable, and especially so as among the Mexicans the quadritubercular form predominates. There were comparatively few of the full five-cusped type observed among them, and why their relatives of the Mississippi valley should present the more primitive form is one of the interesting problems of this study.

The third molars presented great variety of forms of degeneracy, as might have been expected with a people whose general dental degradation and variation was so marked.

The upper third molars exhibited quite as much variety of form and degradation as in any races except the very lowest. As the teeth of these peoples were very irregular in type, the third molars were naturally quite erratic as to form, position, impaction, suppression, etc.

In the Saginaw and Detroit groups they were medium in size and were trapezoid, tricuspid, and bicuspid in form, but with few suppressions.

In the Madisonville cemetery they were medium and of tricuspid and bicuspid forms, some of them being very small. The extensive reduction of size was quite impressive in this group.

In the Turner mounds they were generally large and tricuspid.

In the miscellaneous Ohio mounds they were medium to small and mainly tricuspid to trapezoid.

In the Fox farm, Ky., group, they were medium to small and of tricuspid and trapezoid forms. There were several cases of suppression. One or two had the enlargement caused by the attachment of the fourth molar.

In the Edmonston, Ky., group they were small to medium and of trapezoid, tricuspid, and bicuspid form with some suppressions.

In the Tennessee stone graves they

were small to medium and of trapezoid, tricuspid, and bicuspid forms. Some were wrinkled, as in other groups, a few were large trapezoid and a very few were full type like the first molar.

In the Natchez group they were trapezoid and tricuspid.

The St. Francis, Ark., group were medium to small, trapezoid, tricuspid, and bicuspid in form. No full square crowns were noted.

In the Missouri mounds they were large and trapezoid and tricuspid, and in the miscellaneous mounds were of much the same type.

The lower third molars presented the same general irregularity of form, but not to the same extent as the uppers. This greater constancy of type is common to all of the higher races in this tooth. The common forms were the fifth and fourth tubercles, and some enlarged as if by the addition of the fourth molar. Impaction was far from infrequent, the usual form being that of tipping against the second molar. There were some suppressions, but not a large proportion.

In the Saginaw and Detroit groups this tooth was large and flaring, with the full typal five tubercles, or four or wrinkled.

In the Madisonville group, there were the five and four tubercles and irregular and wrinkled forms. Some were enlarged by the addition of the fourth molar. The prevalence of this enlarged type was quite conspicuous.

In the miscellaneous Ohio mounds the types were much the same, but very uncertain—the fifth, fourth, irregular and wrinkled; some few were irregular three-cusped.

In the Fox farm, Ky., group they were irregular—four and five irregular and wrinkled, large and small, and some enlarged like the addition of the fourth; very few were of full type like the first.

In the Edmonston, Ky., group they were large and irregular, four and five cusps and wrinkled, etc.; a few had the fourth molar added.

In the Tennessee stone graves they were large and irregular—four and five tubercles, wrinkled, fourth molar added, etc. Some few were of the full square type like the first. There were quite a number of impactions in this group.

In the St. Francis river, Ark., group they were of much the same type—four and five tubercles and irregular, wrinkled, etc. There were many cases of suppression here, more than in the last.

In the Missouri and miscellaneous mounds the proportion of the types was about the same.

As to generalizations and deductions, there is not much to be said. The groups covered were not sufficient to form generalizations for the whole Mississippi valley, and yet were complete in themselves. It is highly probable that distinct types of physical organization were developed after the dispersion subsequent to the invasion from Mexico, and that sufficient time had elapsed to effect a positive differentiation in somatological characteristics from the time of the dispersion to that of the destruction of the civilization by the incoming from the north of the Indians known to history. This differentiation is well shown in the variability of the teeth, especially of the molar elements. These variations in form and types of degeneracy are very remarkable and we cannot as yet read their meaning, but they serve to sharpen the appetite to know more of kindred peoples in order that we may trace their affinities and relationships; for it is becoming apparent that just as truly as the history of the evolution of the molars throws light upon the phylogenetic history of the mammalia, just so surely does the study of the human molars throw light upon the history of the evolution of the human race and upon the ethnological relationship of races. We can and will make a great contribution to the solving of many knotty ethnological problems by the more extensive investigation of ethnographic odontology; and for that great purpose, as well as for other important considerations in regard to adding to our knowledge of the dental organs themselves for its own value, I would again urge the pursuit of the subject in fields that may be accessible to students in all parts of the world.

The CHAIRMAN. You have listened to a most instructive and interesting essay, and we can but compliment the author on the valuable information contained in his communication. Dr. Thompson has for years devoted himself in a most unselfish manner to unearth data of untold interest to the student of anthropology, and we feel indebted to him for presenting to this section the result of this part of his investigations.

The CHAIRMAN. Dr. Eugene S. Talbot of Chicago was to read a paper in this section today on "Anatomic Changes in the Head, Face, Jaws and Teeth in the Evolution of Man." When first appointed chairman of this section I wrote asking Dr. Talbot for a paper. He accepted at once, and the first paper I received was from him. Yesterday I was notified by the secretary-general that one of our papers should be turned into the general session to be read in the morning, and after considering the matter thoughtfully I concluded that Dr. Talbot's paper was the one best adapted for that purpose. Therefore, with the permission of this section it will be transferred to the general session.

Dr. LITCH. I move that the paper of Dr. Talbot be transferred as suggested by the chairman.

The motion was carried.

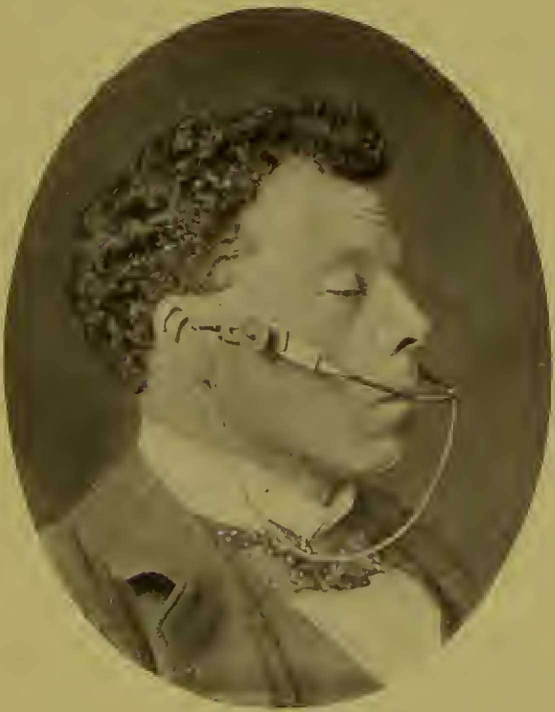
The secretary, Dr. Hough, read a paper by Mr. Geo. G. CAMPION of Manchester, Eng., on "Some Graphic Records of Movements of the Mandible in the Living Subject, and Their Bearing on the Mechanism of the Joint and the Construction of Articulators," as follows:

Some Graphic Records of Movements of the Mandible in the Living Subject, and Their Bearing on the Mechanism of the Joint and the Construction of Articulators.

By **GEORGE G. CAMPION, L.D.S., Manchester, Eng.**

THE problem of the exact elucidation of the movements of the mandible must be of interest to all dentists who are trying to achieve success in the construction of an anatomical articulator. The method here described of following these movements, and the accompanying graphic records of actual movements in the living subject, may, I hope, interest this section.

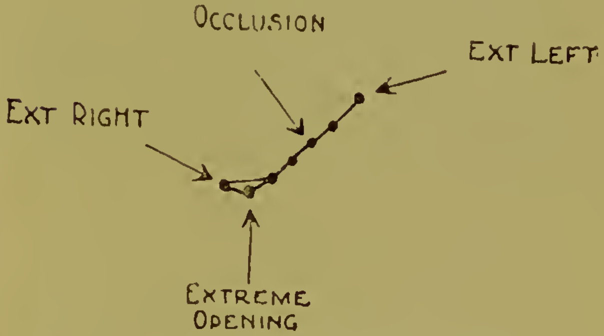
FIG. 1.



Instrument in position.

Fig. 1 shows in position an instrument consisting of a small tray, shaped like a lower impression tray but without a handle, to the anterior border of which are fixed two brass rods. These issue from the mouth and are bent upward and outward to conform approximately to the contour of the cheeks. To each of them is fixed a plane surface of brass, the two surfaces on opposite sides of the face being arranged parallel to one another. On these slide two other plane surfaces, the positions of which can readily be adjusted and fixed by thumb-screws. Each of these movable planes carries a brass tube which can readily be fixed in a position exactly over the corresponding condyle after its position has been ascertained by palpation. By getting the patient to move the mandible from side to side the positions of the condyles can

FIG. 2

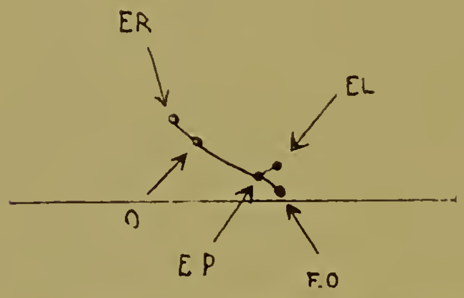


Left condyle. Path nearly straight.

In the diagrams the lettering indicates—O., Occlusion; E.L., Extreme Left; E.R., Extreme Right; E.P., Extreme Protrusion; E.O., Extreme Opening.

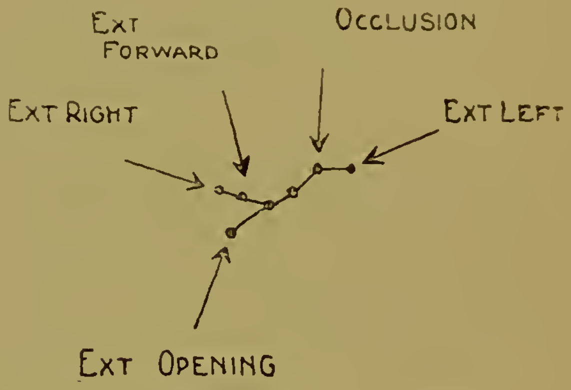
be determined with ease and the tubes fixed exactly over them. When the tubes have been thus adjusted they project from the sides of the face perpendicularly to the skin covering the condyles. A pointed piece of brass rod slides easily but accurately in the tubes, and after the instrument has been fixed rigidly to the lower teeth by modeling composition and the tubes accurately adjusted, the point of the sliding brass rod being charged with some coloring matter which does not readily dry (such as rouge mixed with oil to a creamy consistence), the varying positions of the condyles can be readily indicated by a succession of dots on the skin. A piece of white blotting-paper is then gently pressed over them, and from this the record can be easily transferred to paper or a ground-glass lantern slide. By using a piece of blotting-paper about three inches long by one inch broad with a penciled line drawn along the middle of one surface from end to end, it is easy to record the relation of the condyle path to an imaginary line from the external auditory meatus to the lower border of the nose, and thus show approximately the relative slope of the condyle path in different individuals. The positions recorded explain themselves when it is stated that in those of extreme protrusion and extreme right and left the teeth were as nearly closed as the apparatus would permit.

FIG. 3.



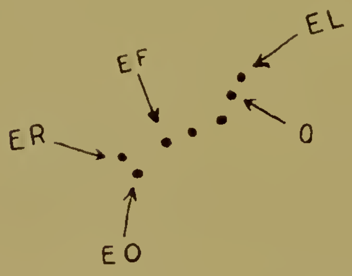
Right condyle. Path nearly straight.

FIG. 4.



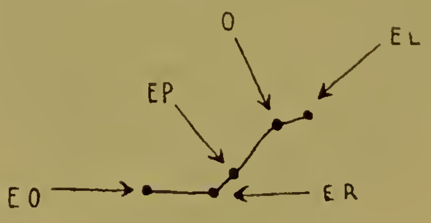
Left condyle. Path sigmoid.

FIG. 5.



Left condyle. Path irregular.

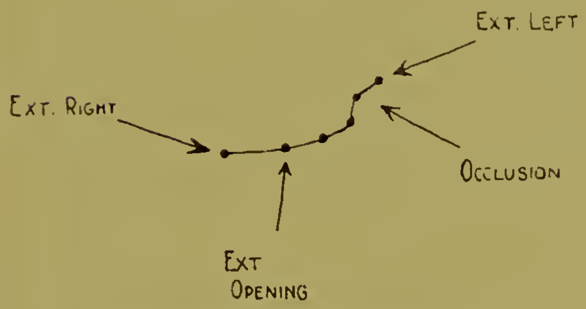
FIG. 6.



Left condyle. Path sigmoid.

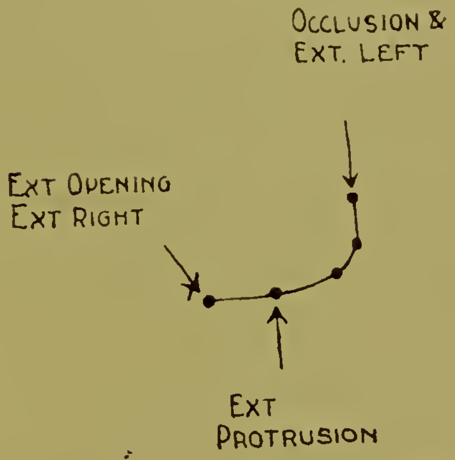
The accompanying records of actual condyle paths in different individuals show wide variations—an almost straight line, sigmoid curves of differing lengths and curvature, and curves of unequal convexity. The slope of the condyle path also varies greatly, being usually downward and forward, but often nearly horizontal, in one case of those shown being forward and actually upward. Now, these variations in a number of unselected cases show at a glance how futile must be any efforts to construct an anatomical articulator on the lines of Bonwill, Walker, Schwartz, Christensen, and Gritman, and that no articulator can be in any real sense "anatomical" in which the condyle paths are not capable of being specially arranged and adjusted for each individual case. To Mr. J. B. Parfit of Reading, Eng., belongs, I believe, the credit of being the first to construct an articulator which embodies this essential point.

FIG. 7.



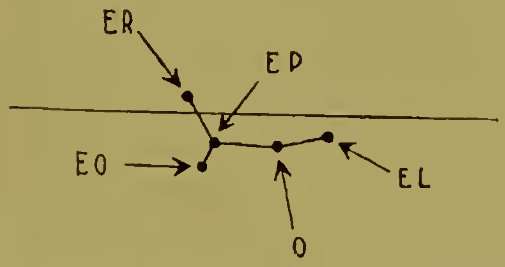
Left condyle. Path sigmoid.

FIG. 8.



Left condyle. Path markedly convex downward.

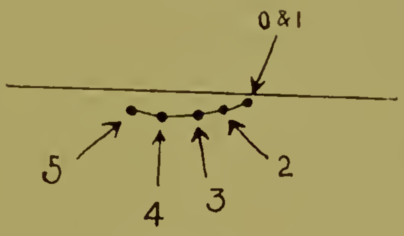
FIG. 9.



Left condyle. Path markedly convex downward, but the sliding movement is forward and upward. This was associated with great attrition on all the teeth.

Three other slides represent the positions of the condyle in occlusion and when opened successively to the extent of one, two, three, four, and five centimeters—except, indeed, where the mouth could not be opened to this full extent. In obtaining these three tracings care was taken that in closing on the pieces of metal of these different measurements

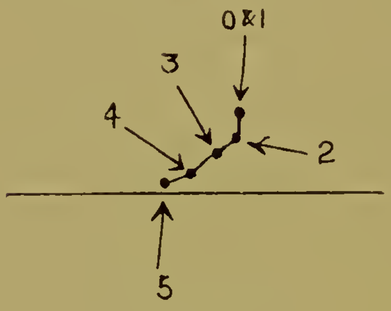
FIG. 10.



Left condyle.

the mandible was not in any way protruded, but was held back as far as possible in the position which obtains in occlusion. It will be noticed in these tracings that the position of the condyle in occlusion coincides exactly in two cases with its position where the amount of opening is one centimeter, and in the third case with the position where the opening has been to the extent of two centimeters.

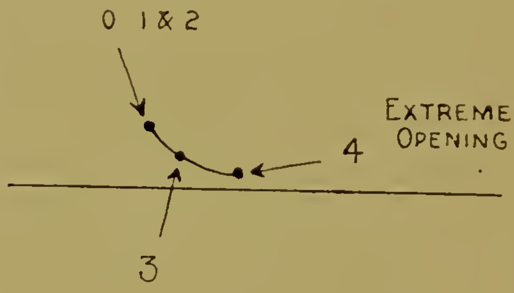
FIG. 11.



Left condyle.

FIGS. 10 AND 11. Showing relative positions of condyle—at occlusion, and with mouth opened to extent of 1, 2, 3, 4, and 5 centimeters respectively.

FIG. 12.



Right condyle. Relative positions of condyle—at occlusion, and with mouth open 1, 2, 3, and 4 centimeters respectively.

It has been suggested that in the movement of opening the mouth the mandible rotates about an axis situated about one and a half inches below the two condyles, and that an articulator should be so arranged that its hinge should be placed in approximately a corresponding relation to the teeth of the case under treatment. From the various curves shown it would seem that both these conclusions are erroneous, and that there is and can be no one axis about which the mandible moves in opening the mouth, but that the movement is a complex one, consisting first of a rotation of the bone on an axis passing approximately through the centers of the two condyles, and secondly of a forward and downward movement of the condyles as they slide over or with the meniscus-shaped interarticular cartilage along the curve of the eminentia articularis. The actual movement would seem to be a complex one, consisting approximately of more or less simultaneous rotation about two axes, one passing through the centers of the curves of the articular surfaces of the two condyles, the other through the centers of the curves of the two eminentiæ articulares. It will also be clear that if in opening the mouth to the extent of one centimeter the movement is one of rotation about an axis passing through the two condyles, then in adjusting models to an articulator they must be so arranged that the hinge of the articulator must be in the same relation to the teeth or alveolar processes as the centers of the condyles are in the living subject. The only part *of the opening movement* which an articulator is concerned to reproduce is the initial stage, which is seen in the tracings to be a simple rotation about an axis passing through the condyles.

Discussion.

Dr. C. R. Turner, Philadelphia, Pa. I wish to say that I am most heartily in sympathy with every effort that is made in the line of securing a precise record of the movements of the mandible with a view of studying those records to the end that an articulator may be made which shall accurately reproduce those movements. The articulator problem appears to me in one of two ways. It is necessary either to view it as an instrument of absolute precision, which shall be set so that it represents the possibility of movements of the mandible for each individual case for which it is used, or as an ideal which is obtained from a composite study of the movements of many jaws. It seems to me that the first of these methods of viewing the articulator problem is essentially the correct one. As Dr. Luce said in his article published in the *Boston Medical and Surgical Journal* a good many years ago, the first thing in the study of the movements of the jaw is to get a record of them. Therefore I say that I am heartily in sympathy with the spirit of Mr. Campion's paper and with his efforts to obtain accurate records of the movements of the mandible.

Now, the question is as to whether this method is one which will produce accurate results. I should doubt very seriously whether dots placed upon a movable tissue like the skin would accurately record the position of the condyle. Mr. Campion's method of transferring them to a lantern slide or other fixed surface is also open to the objection of inaccuracy. However, I feel that he is quite correct in his statement that the path of the condyle is by no means a straight line, and therefore that instruments which are constructed along the lines of those in which that path is represented as a straight line are constructed upon incorrect principles. And, as he has said, Mr. J. B. Parfit of England is the only one of whom I know who has made any attempt to represent this condylar path by anything except a straight line.

But this is only one phase of the movement of the mandible, and that phase deals with the movement of extreme opening and closing and the movements of incision. The lateral movement of the jaw is one which it seems to me is more important from the standpoint of articulation in dental prosthesis than the forward or the up-and-down movements. I say this because it is of course during the lateral excursion of the jaw and its return to a position of occlusion that mastication of food takes place; and it is during this movement that the teeth must be placed in correct relation to each other so that mastication shall take place. It is very important that the pivotal point about which the jaw makes its lateral excursion in both directions be determined. It has been stated arbitrarily that the mandible rotates about the center of the condyle. I cannot refute this statement by recorded evidence, but I offer this as substantiating my belief that the condyle is not necessarily the point about which the jaw rotates. John Ryder, in an article published in the proceedings of the Academy of Natural Sciences of Philadelphia in 1878, called attention to the fact that, from observation of many skulls of herbivora, reference to the groove which had been worn in the teeth by the lateral excursions of the mandible showed clearly that in some cases the rotation could only have been about a point midway between the condyles; that in others it was about points between this center and the condyles themselves, and that in others, again, it was within the condyles themselves. We see therefore in animals whose principal mandibular movements are lateral, that the center of the condyle is not necessarily the point about which rotation takes place.

Dr. Walker, in an article published in the *Dental Cosmos* in 1896, makes the statement that in the lateral movement of the human mandible in some cases he has observed that as the condyle moved forward on one side, there was a backward movement of the other condyle which in some cases amounted to an eighth of an inch. Therefore it seems to me that there must be definite points about which that rotation takes place, and it appears to me that it is necessary, in addition to securing a record of the directions and form of the condylar path, that we secure a record of the axes about which this rotation of the jaws in the horizontal plane takes place. When that has been accomplished, I think another step will have been taken in the matter of solving the problem of reproducing by an instrument all the movements of the mandible.

At this point Dr. C. R. Turner took the chair.

Dr. Cryer. Mr. Chairman, I wish to say a few words. The subject of the movements of the mandible is a very interesting one, not only from the standpoint of the prosthetic dentist, but from the standpoints of the anatomist, the physiologist, and even the pathologist. Even our best anatomists speak of the mandible swinging from the point of the condyloid process. It certainly does swing against this pivotal or focal point when the mouth is slightly opened—say perhaps in opening it not more than half an inch between the incisal edges. Such action does not change the pivotal point; but at the very moment the jaws are opened wide enough to take in food the arrangement is changed, and the mandible acquires the character of a floating bone, just as is the case with the hyoid bone. We cannot give any specific description of the movements of the hyoid bone for this reason, viz, that it has no bony articulation. It is controlled by muscles from above, below, anteriorly, and posteriorly, and even muscles coming from various directions control its movements. It will rock or move according to the tension of any one of those muscles, or to the combination of their individual forces. We could not say what the pivotal point is of the hyoid bone. I am inclined to class the pivotal point of the mandible very near to that of the hyoid bone. In a simpler movement, I think, it is at the articulation within the glenoid fossa; but the moment the bone is pulled forward by the external pterygoid the pivotal point changes, perhaps downward and forward in the direction of the inferior dental foramen, and then it will follow a curved direction from that point to the angle of the mandible.

In making X-ray pictures, where the mouth is closed and then slightly opened, the condyloid process is within the glenoid cavity; but beyond these movements it is found to have come forward and downward, resting along the border of the eminentia articularis. We find that this focal point changes so much and so variously that it may become a fixed point at some position, and then, by the action of the external pterygoid, that muscle becomes the opener of the mouth instead of the one to draw it forward. The head of the condyloid process becomes part of the lever to which the force is applied. Therefore the fulcrum is changed, and by its action it succeeds in opening the mouth as well as having the ability to draw the mandible forward.

The paper that has been read before us is very interesting, and I believe that a similar arrangement could be made and attached to the teeth, but instead of having a rod only going up in the region of the condyle, if we will model a piece of brass plate similar to the size of the ramus and the body of the jaw, and have this arrangement made fast to the teeth, I think that then by studying many cases we could get a composite idea, and could watch and see where the pivotal point changes.

In his remarks Dr. Turner spoke of the pivotal point changing from one condyle to another, bilaterally, as I understand.

Dr. **Turner**. Yes.

Dr. **Cryer**. I am speaking of the pivotal point changing from the condyle down, while Dr. Turner spoke of its changing transversely. Now, if the pivotal point of the mandible changes horizontally and perpendicularly, the centers of the movement of the jaw will also be at any point between them. So it is exceedingly variable, and I do not believe we can in any way make an articulator on anatomical lines that would be adapted to all cases. We shall have to make an articulator—as Mr. Campion said, I believe—to suit individual cases.

As Mr. Campion is not present, of course he cannot answer the remarks which have been made, and so I will declare the discussion on this paper closed.

The Secretary then read the paper by Mr. J. G. **Turner** of London, Eng., entitled "The Influence of the Growth of Bone on the Arrangement of the Teeth," as follows:

The Influence of the Growth of Bone on the Arrangement of the Teeth.

By Mr. J. G. TURNER, London, Eng.

What I wish to suggest to you is briefly this—That the normal orderly arrangement of the teeth in the jaws is the result of normal growth of the bone, and, as a corollary, that most deformities of the dental arch are a consequence of disordered growth of bone.

The most striking instance of the dependence of the teeth on the bone is seen on the eruption of the three permanent maxillary molars. When first laid down the occlusal surface of each one in turn faces backward. With the backward enlargement of the maxilla (and antrum) the tooth becomes rotated and carried downward till it erupts with its occlusal surface opposing the lower teeth. To a less marked degree this takes place in the mandible; the three permanent mandibular molars are first found with their occlusal surfaces looking forward and upward; with the growth of the bone the tooth is rotated till it erupts with its occlusal surface facing the upper teeth.

Again, in the normal process of growth the temporary front teeth become markedly spaced before they are shed and carried forward by the normal growth of bone.

That bony growth is capable of bodily translating a forcing tooth, capsule and all, is seen in what happens to the lower bicuspids after early extraction of the first permanent molar. The tooth is carried backward till it is arrested by the second molar. Fig. 1 shows a case in which the second bicuspid is erupting in this position, and Fig. 2 a case in which the teeth are being carried backward after eruption. These cases are from my own patients, and I can vouch for the extraction of the first molar. Such movement is by no means uncommon, but the amount of movement varies with the interlocking of the bite, the action of the lips and the mechanical stress of mastication, which may force the second molar forward.

Fig. 1.

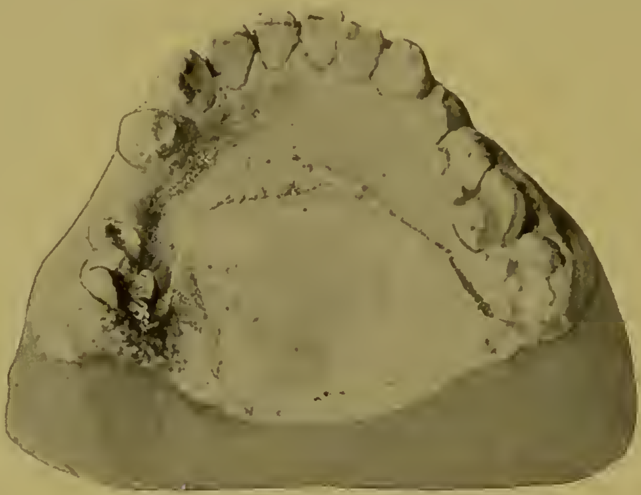
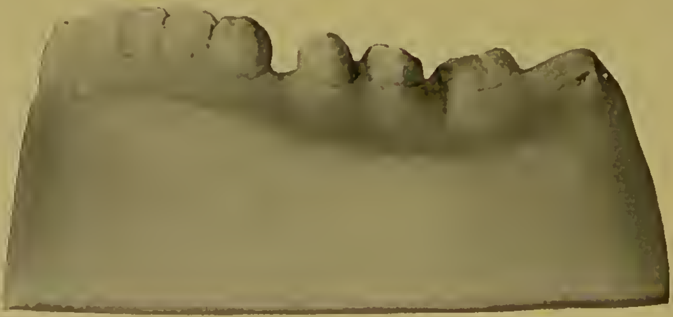


Fig. 2.



Now, if these movements be due to growth of bone, we ought to find corresponding abnormalities in cases where bony growth is interfered with. That is, if the growth of bone is partially or practically suspended during a certain period, we ought to find the teeth of that part fixed in positions corresponding to the places they should have obtained at the date of this suspension; if growth has been only slowed, then they should be found in positions more or less nearly approaching the positions they should take up at an early period of life. Briefly, the teeth should retain more or less their fetal positions, if the word fetal may be applied so far forward in life.

FIG. 3.

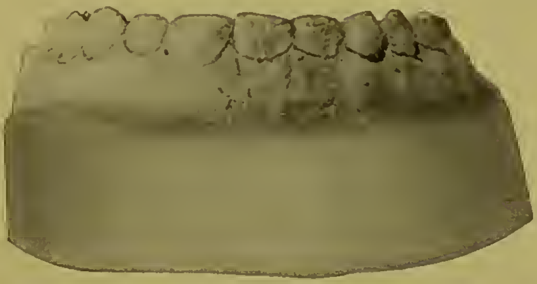
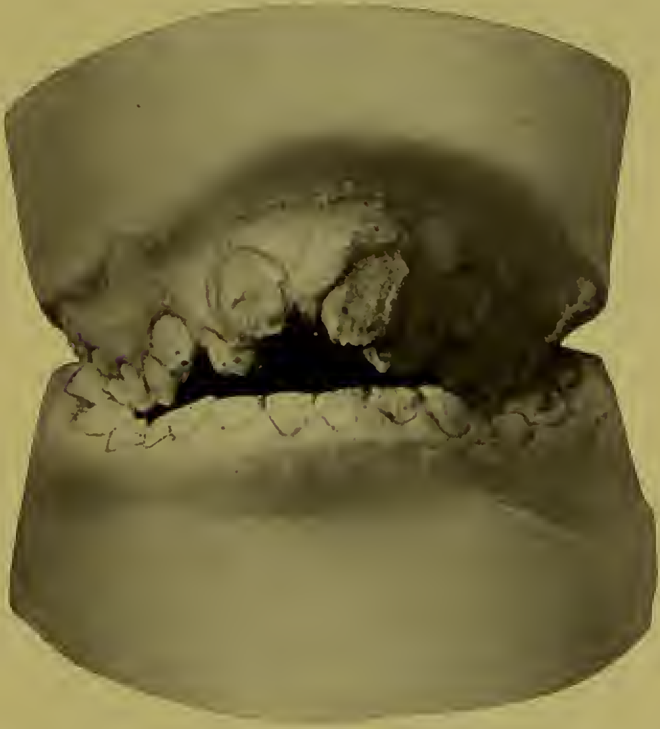


FIG. 4.



Cases of persistent naso-pharyngeal obstruction afford us a ready means of testing this theory. In these cases there is want of growth of all the bone forming the upper air-passages, including the maxillæ. Now if we examine a child of from five to six years who has for some time been the subject of marked adenoid obstruction, in place of the normal spacing of the front temporary teeth they will be found unspaced or even crowded in a manner recalling their earlier relative positions before eruption. (Fig. 3.)

Consider such a case of open bite as is shown by Fig. 4. It is from an adenoid boy of twelve. Obviously the front parts of the maxillæ are deficient in vertical or in lateral dimensions. Had growth of bone progressed normally the teeth would have been carried down to a normal occlusion and outward to a regular arch. But growth has failed, and the teeth are left in positions, or nearly so, which once were normal to them.

Fig. 5.

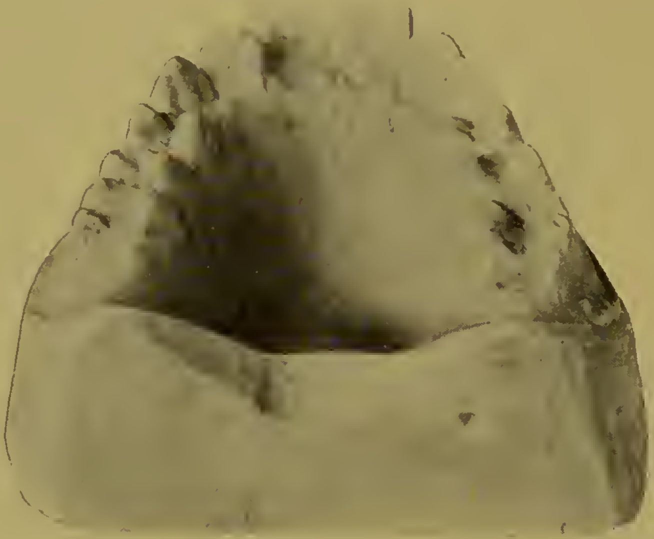
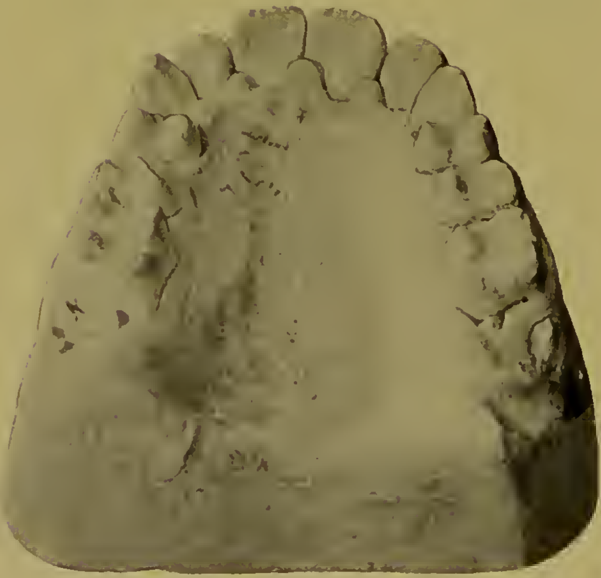


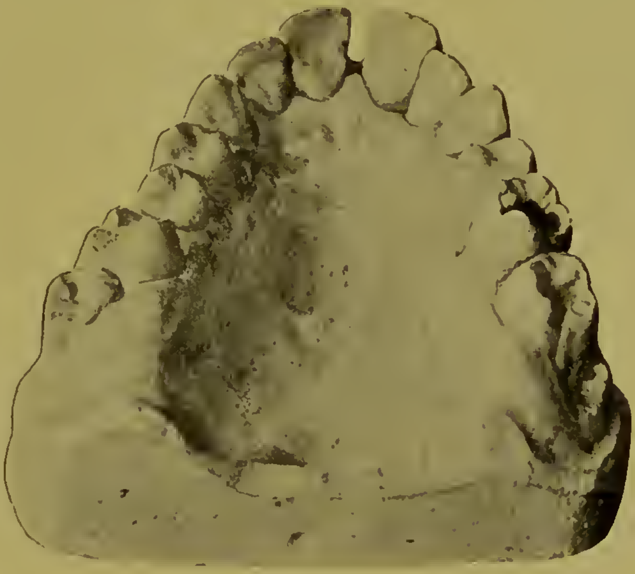
Fig. 6.



Now consider the familiar V-shaped or saddle-shaped arch. Fig. 5 is from an adenoid child of eleven with upper protrusion. At this age she was operated on and the obstruction cleared away. Normal growth was resumed and the second molars were erupted in positions belonging to a wider and more normal arch than is occupied by the more anterior teeth. (Fig. 6.) Had the obstruction persisted, there would have been no such obvious amelioration in the width of the arch, and the teeth would have erupted in positions corresponding to the want of (lateral) growth of the maxillæ.

If the patient be left to "outgrow" his adenoids, in many cases he will partially do so, and the result will be seen in the positions of the second and third molars. Fig. 7 shows such a case. The second molars are in positions in a rather wider arch, and the third in a far wider one. The widest part of the dental arch is now at the third molars instead of at the first. With the resumption of growth the second and third molars have been carried outward to more nearly normal positions, while those parts whose growing period has passed have been left in their abnormal state.

FIG. 7.



These considerations have suggested to me that we do not give sufficient importance to growth as a factor in dental arrangements. I do not suggest that this stands alone as the only factor, nor that teeth do not react on the bone. There are such other factors in producing the various dental arrangements commonly found as pressure of cheek and lips, etc., and the alveolar part of the bone shows a marked dependence on the presence of teeth for its existence. But the disengagement of the teeth from their "fetal" positions and their translation to their positions in a normal arch is the work of growing bone; and whatever interferes with growth interferes with the perfection of the dental arch, and when the growing period has passed any deformity that is left is permanent.

Discussion.

DR. E. S. TALBOT, Chicago, Ill. Mr. Chairman, I regret that the author of this interesting paper is not here, since I dislike to criticize a paper in the author's absence.

The paper is on rather narrow lines; it is, however, one that might bring out considerable discussion. It deals solely with the local conditions, and purely from the dental standpoint. That bone alone has to do with the development of the teeth is quite open to question—if it has very much to do with it, except in hypertrophy. Where there is hypertrophy of the alveolar process the bone does move the teeth in different directions; the cases here cited are not, however, due to the development of the bone, but simply to the attempt of the teeth to find places to establish themselves, so to speak—or to find a resting-place. If a space be left in the dental arch, and the alveolar process and the bones are developing, the teeth will move either backward or forward as the case may be, to find a resting-place; they sometimes rotate.

To discuss this subject intelligently the pre-natal conditions must be considered. But unfortunately there is a dental trend to look upon all pathological states as being due to local conditions in and about the mouth itself. The influence of the constitution, of embryology, and of evolution is frequently ignored.

Adjourned.

SECTION I—Continued.

THIRD DAY—Wednesday, August 31st.

The section was called to order at 2.30 P.M. by the chairman, Dr. M. H. Cryer, who called Dr. R. Ottolengui, New York, to the chair.

Dr. M. H. Cryer then read his paper entitled "Some Uses of the Roentgen Rays in Studies of the Internal Anatomy of the Face," as follows:

Some Uses of the Roentgen Rays in Studies of the Internal Anatomy of the Face.

By M. H. CRYER, M.D., D.D.S., Philadelphia, Pa.,

PROFESSOR OF ORAL SURGERY, UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

The study of applied or surgical anatomy by the method of sectionizing the head and face has demonstrated that the internal anatomy of the face is not the same in different subjects; that, in fact, in the same individual the two sides of the face often vary markedly. The knowledge thus gained has been of the most practical importance to the surgeon, whether in the special fields of rhinology, ophthalmology, or stomatology. It is, however, often desirable to make a study of the internal anatomy of the face and of the movements of the mandible in the living subject. The pneumatic sinuses and cells vary so much in their shapes, sizes, and outlets that it is impossible to get a definite knowledge of them in a given living subject, or by studying them from sections alone, and it is often important to know the density of living bone and the position of the various structures before undertaking a surgical operation.

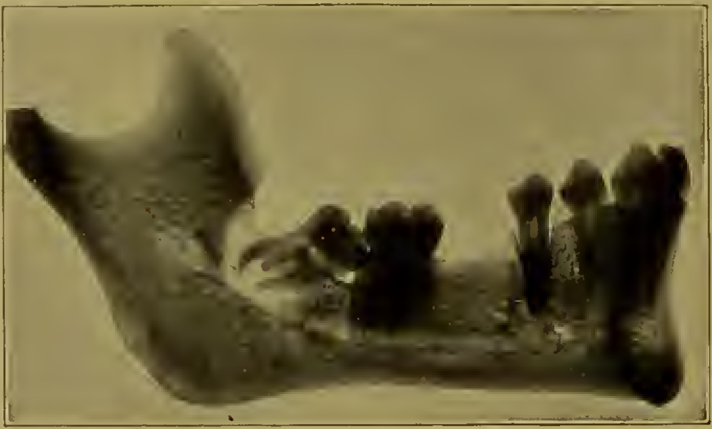
During the last decade the employment of the Roentgen ray has come into general use in various ways in both the medical and dental professions. Its most important service has been in the localization of foreign substances, pathological deposits, fractures and dislocation of bones, the over-calcification of bone, and other pathological conditions, the treatment of various diseases, etc. It has also been employed to a slight extent in the study of normal anatomy. It is along this line of work that your writer wishes to speak particularly.

The movement of the condyloid process within the glenoid fossa and its relation to the eminentia articularis at the various stages of the advancement of the mandible and the different degrees of opening of the mouth can be studied fairly well by the ordinary X ray, but when we reach the pneumatic sinuses and cells of the face it is necessary to use the more advanced radiograms. Those who have worked with so much energy upon this line of investigation are entitled to the greatest credit for the fine results obtained.

ORDINARY AND "STEREOSCOPIC" RADIOGRAMS.

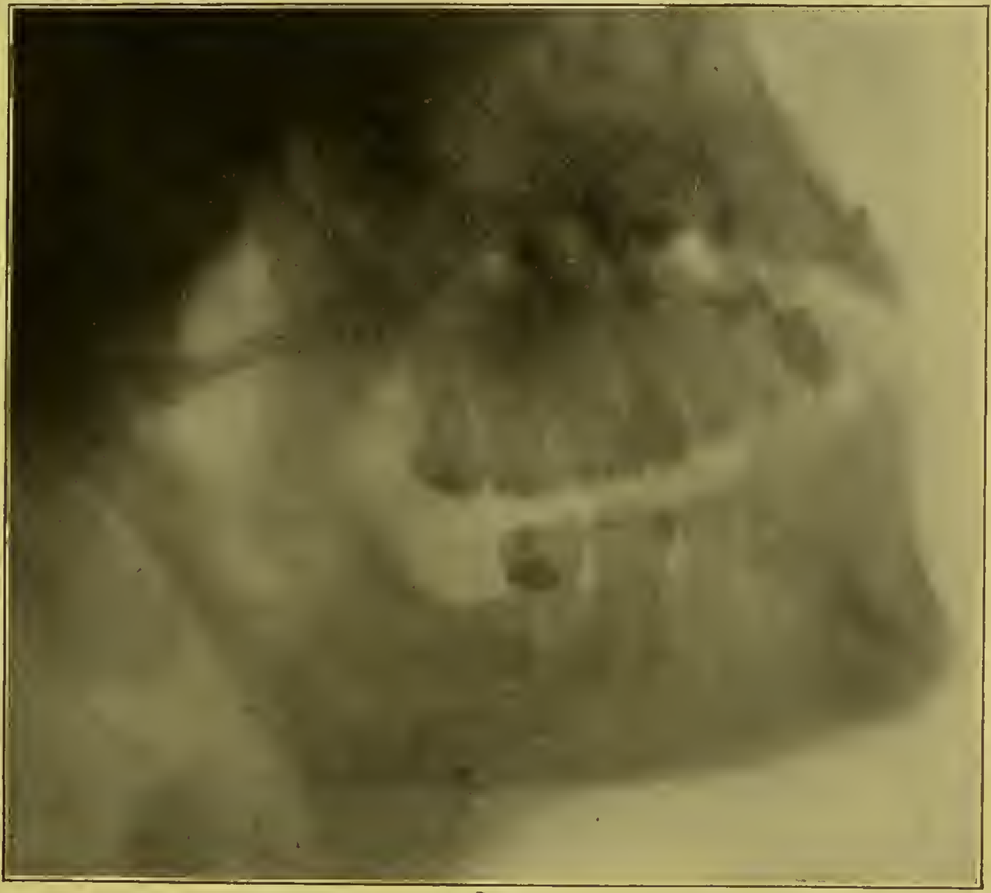
During a visit of the writer to Dublin in the summer of 1903 he had the pleasure of seeing stereoscopic work of this character done by Dr. Wm. S. Haughton. Not until that time had he thought it practicable to make stereoscopic X-ray pictures of the living subject for the purpose of studying the internal anatomy of the face. Immediately on his return the writer consulted his colleague, Dr. Kassabian of the Philadelphia Hospital, and under his instructions and with funds supplied by the dental department of that institution, a complete apparatus was constructed for making stereoscopic X-ray pictures of any portion of the body. Experiments were first made with the cleaned skull, with fairly good results. Then plates were made from the living subject, but, on account of the density of the tissues of the head and face, the time of exposure necessary was considerably longer than is required for other portions of the body, which made it difficult for the patient to keep perfectly still during and between the two exposures.

FIG. 1.



Even by studying dried bones with the ordinary X-ray pictures, many interesting facts can be shown. For instance, a good picture was made of one-half of a cleaned or dried mandible showing the general outline of the bone. (Fig. 1.) The variations in density are seen, with the cancellated tissue situated between the cortical portions of the bone; the positions and shapes of the roots of the teeth, with the nerve canals, are plainly shown, and the inferior dental tube may also be seen. The picture also shows an impacted lower third molar. A *stereoscopic* picture of this character may be made and examined through the stereoscope, when the internal anatomy can be better seen and studied.

FIG. 2.



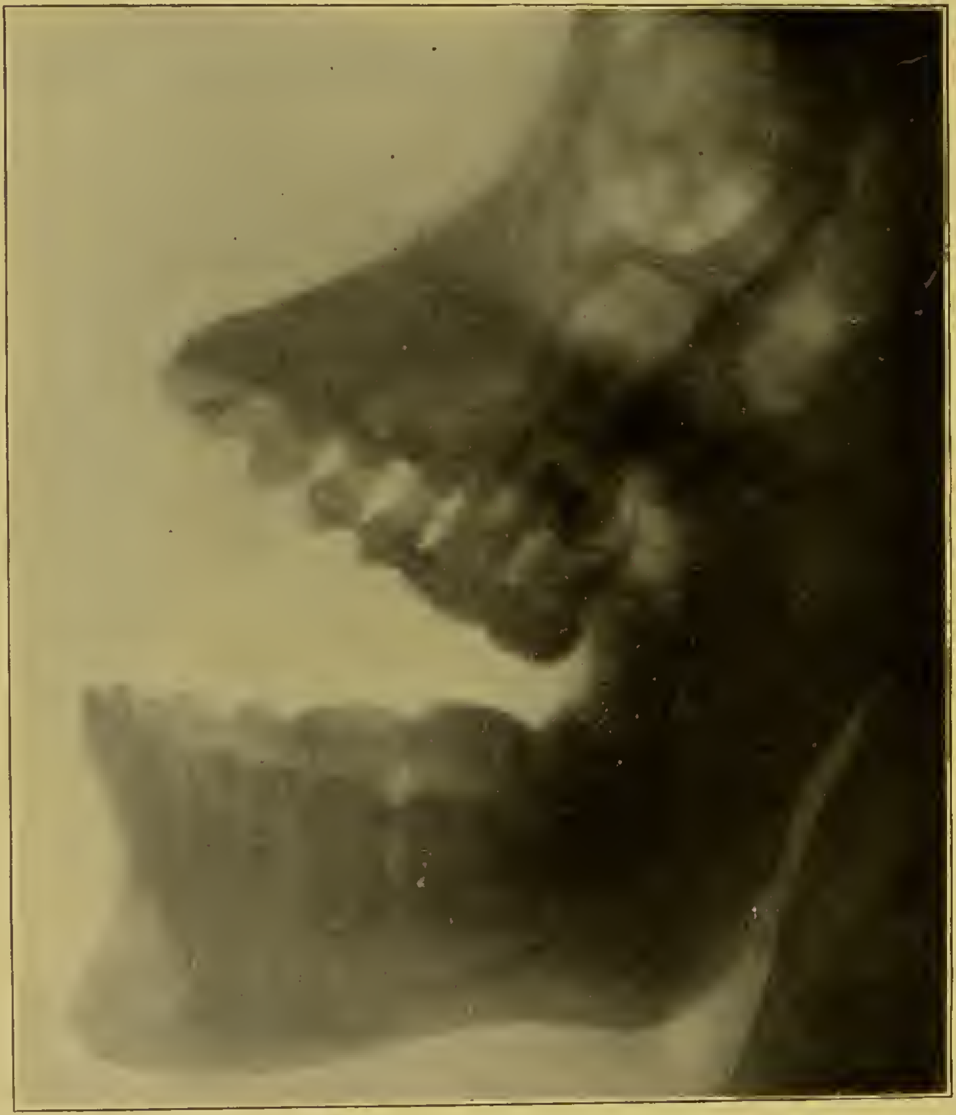
PATHOLOGICAL CONDITIONS.

Fig. 2, a picture of the upper and lower jaws, is from a patient of Dr. Dray of Philadelphia, to whom I am indebted for this illustration. In the lower jaw the dental tube is shown extending nearly the entire length of the bone. The roots of the premolars, the two roots of the first molar, and the anterior root of the second molar are clearly seen, but the distal root is covered by the crown of an impacted third molar. In the region of the impacted tooth there is a cloudiness which indicates that an inflamed condition exists, not only in the bone but also in the surrounding tissue. This is of vital surgical importance; for instance, in this case the patient was suffering from neuralgia at the time the picture was taken, and gave strong clinical evidence of the inflammatory condition in this region, which was caused by the impacted lower third molar resting against the distal root of the second molar. The absorption of the tissue of the root of the second molar proceeded until the pulp was exposed, thus causing the inflammatory condition noted. Upon the extraction of the second molar both the inflammation and the neuralgia subsided.

MOVEMENTS OF THE MANDIBLE.

By means of numerous X-ray pictures of the mandible, taken with the teeth in normal occlusion, with the mouth open, and in various positions between these two, it has been seen that the head of the condyle changed from one position to another. When the teeth were in occlusion, or nearly so, the condyle rested in the anterior portion of the glenoid fossa, as seen in Fig. 2. When the mouth was slightly opened the condyle was seen to be lowered slightly, resting against the articular eminence. When the mouth was forced wide open the condyle was immediately under and resting against the eminentia articularis. In a few cases it was found slightly in advance of the eminence. In all cases examined where the mouth was only slightly opened, the angle of the jaw moved slightly downward and backward.

FIG. 3.



MECHANISM OF THE TEMPORO-MAXILLARY ARTICULATION.

If the mechanism of the anatomy of the articulation of the lower jaw be carefully examined, it will be found that the internal, external, and stylo-mandibular ligaments act as suspensories to the jaws and have a tendency to fix the angle of the mandible when it is carried slightly downward and backward—as when the mouth is partially opened. The muscular fibers of the internal pterygoid and the external portion of the masseter muscles have the same tendency. The condyloid process of the mandible acts as the fulcrum or pivotal point of the bone. The point or fulcrum moves forward with its cushion, the interarticulating fibro-cartilage, mainly through the action of the external pterygoid. While the jaw is being carried forward the mouth can be opened slightly, still retaining the fulcrum or pivotal point at the end of the condyle, but as the mouth is opened wider the fulcrum is gradually changed from the condyle toward a more central portion of the ramus and then toward the gonion, the angle probably eventually becoming the fulcral point through the partial fixation of the ligaments and muscles before referred to. By the action of the external pterygoid muscle the condyle is drawn forward and the mouth is thrown wide open, with the condyle under or slightly in advance of the eminentia articularis, as is shown in radiograms taken when the mouth was wide open. It is thus that the external pterygoid becomes an opener of the mouth.

The reason for the change of fulcrum or pivotal point may be found in the condition which obtains in the pharyngeal region. If in opening the mouth wide the head of the condyle acted within the glenoid fossa as the only pivotal point, the lower portion of the ramus, with the body of the bone, the hyoid bone, the base of the tongue, and other associated tissues would be carried backward until the soft tissue coming against the post-pharyngeal wall would interfere with the functions of that region. By the transfer of the pivotal point this possibility is avoided.

Fig. 4.

Fig. 3 was made from an X-ray picture taken while the mouth was wide open. It shows that the condyle has been carried well forward with its upper surface resting immediately under the eminentia articularis. This illustration shows other interesting points. The distal border of the ramus is anterior to the line of the vertebræ, which is the normal position even when the mouth is wide open, as was also shown in Fig. 2. This point will be referred to again.

In nearly all radiograms of the face it is noticeable that the roots of the teeth extend no higher than the line of the roof of the mouth. We have here an example of this. No roots are visible above the dark line found above the teeth, which is the roof of the mouth proper. All the tissues below this line belong to the alveolar process and are resorbed in old age, provided the teeth have been lost. The two circular lines seen in the upper jaws are portions of the walls of the maxillary sinuses.

IMPACTED TEETH.

In the lower jaw, the two lower third molars are shown to be impacted. They were extracted, and Fig. 4 gives the views of the left molar after extraction.

Fig. 5 is from another radiogram showing the position of the point of the condyle when the mouth is wide open.

In Fig. 6 the dark line indicating the roof of the mouth may be seen above all the roots of the upper teeth except the upper third molar. This tooth has been impacted, and having become incarcerated near its place of development has not descended to the line of occlusion. Through its interference with branches of the nerves passing in this region it caused otalgia and other facial disturbances. After extraction of the tooth the trouble ceased. The light space above

FIG. 5.

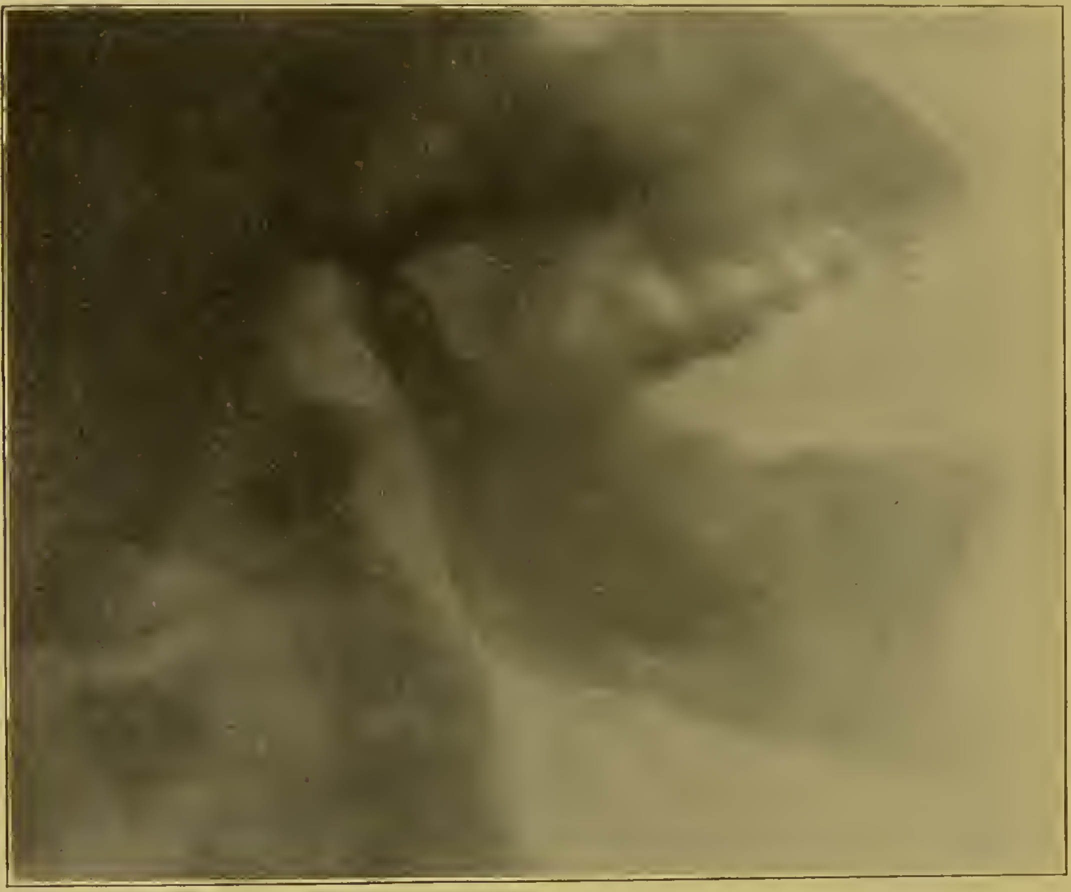
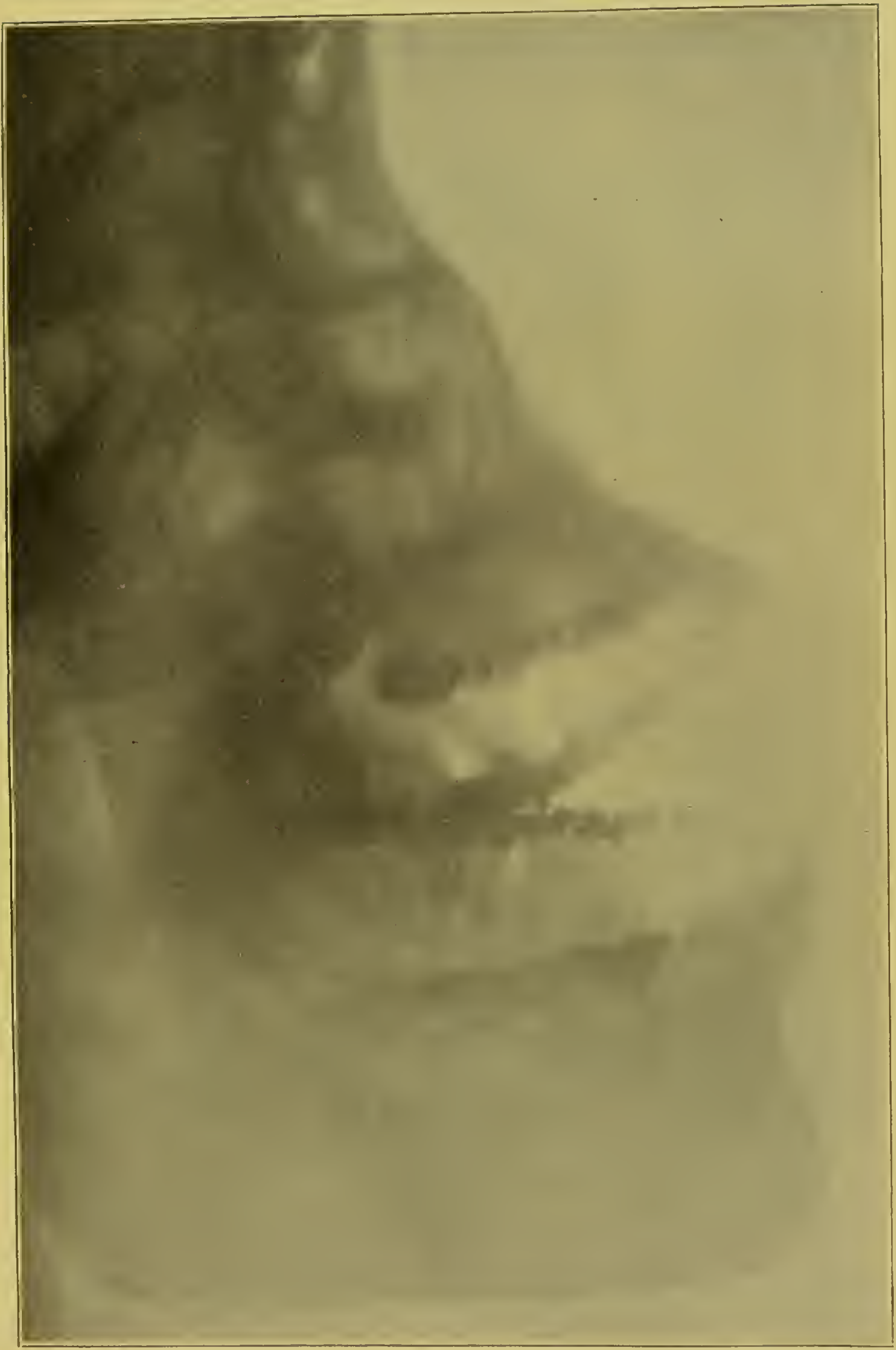


Fig. 6.



the dark line shows the position of the maxillary sinus and nasal fossa.

Fig. 7 gives four views of the extracted impacted tooth visible in Fig. 6.

FIG. 7.

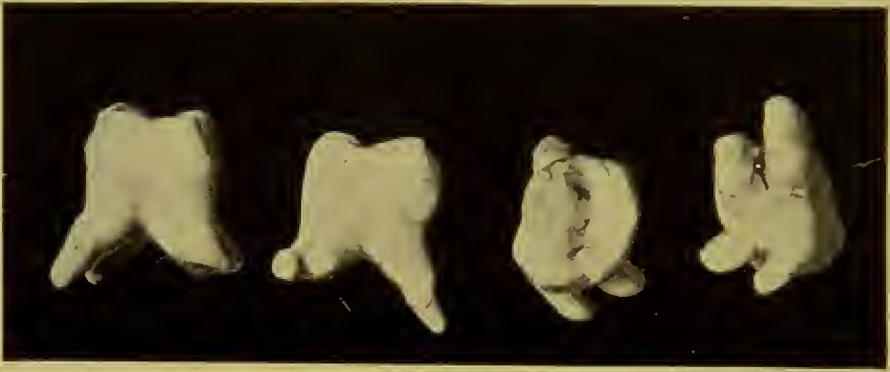
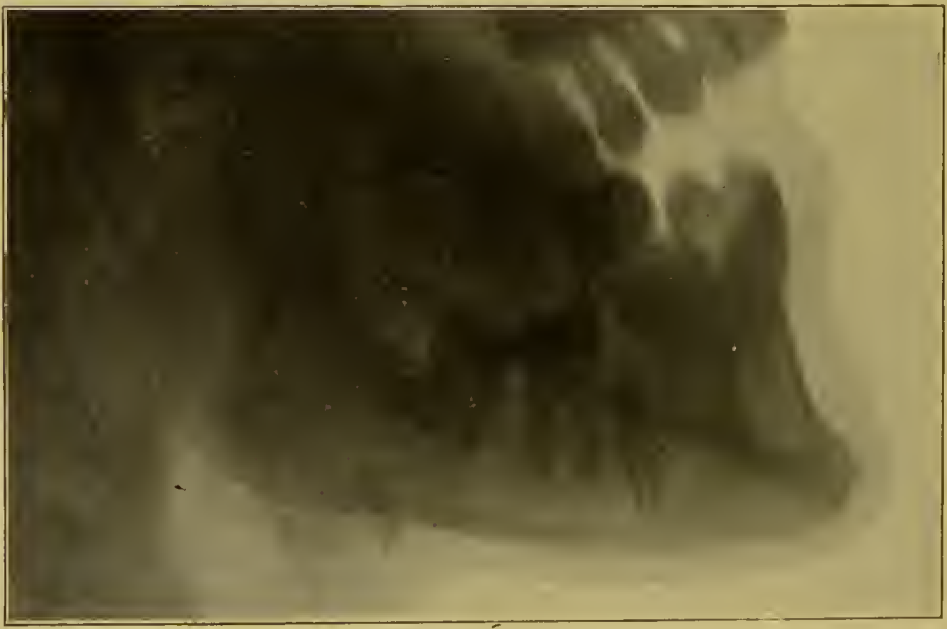


Fig. 8 is from a radiogram of a living subject. It shows very plainly the developing lower third molar with its capsule, a retarded or unerupted second premolar, also the canal or tube passing downward and forward in the ramus. The second molar apparently has four roots; the second premolar seems to have two roots, but this is not the case, the appearance being caused by the incompletely developed apices of the roots. This radiogram was very useful in studying the best method for correcting the malposition of the anterior teeth.

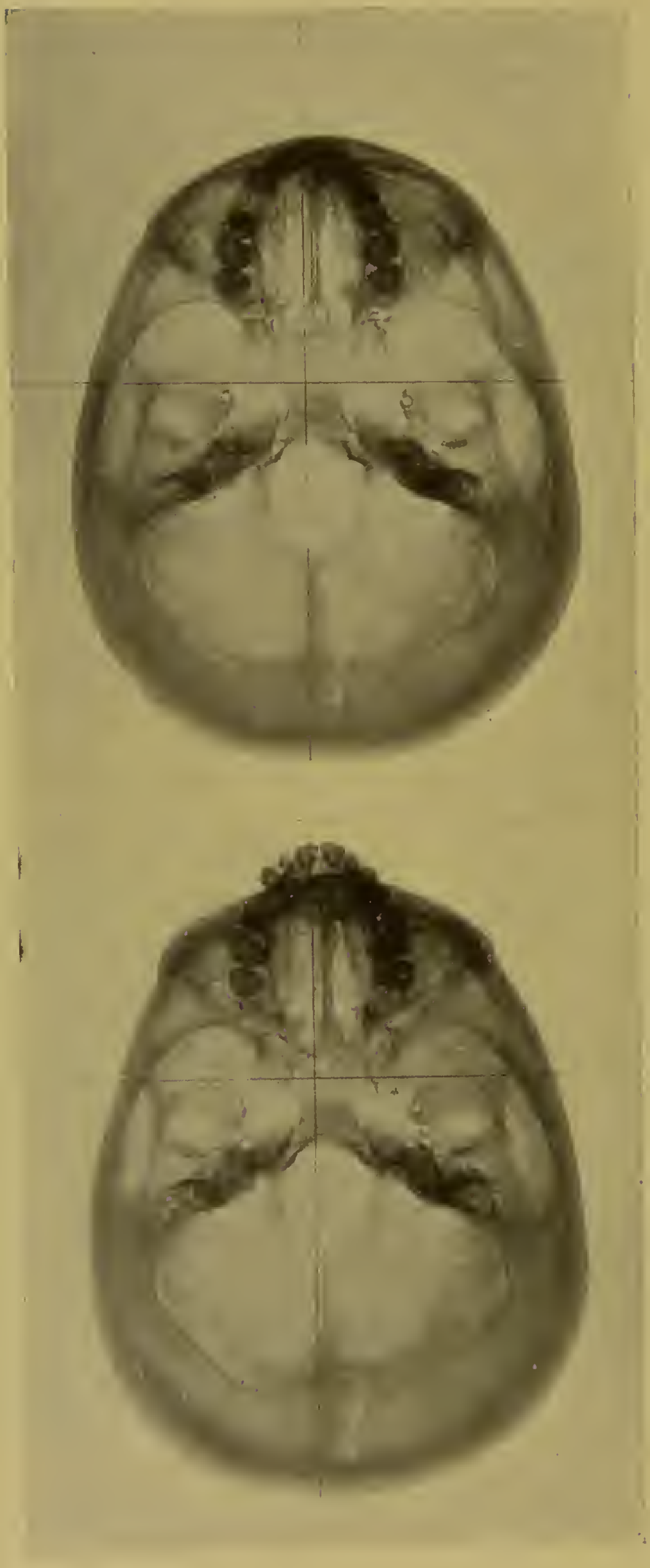
FIG. 8.



STEREOSCOPIC RADIOGRAMS.

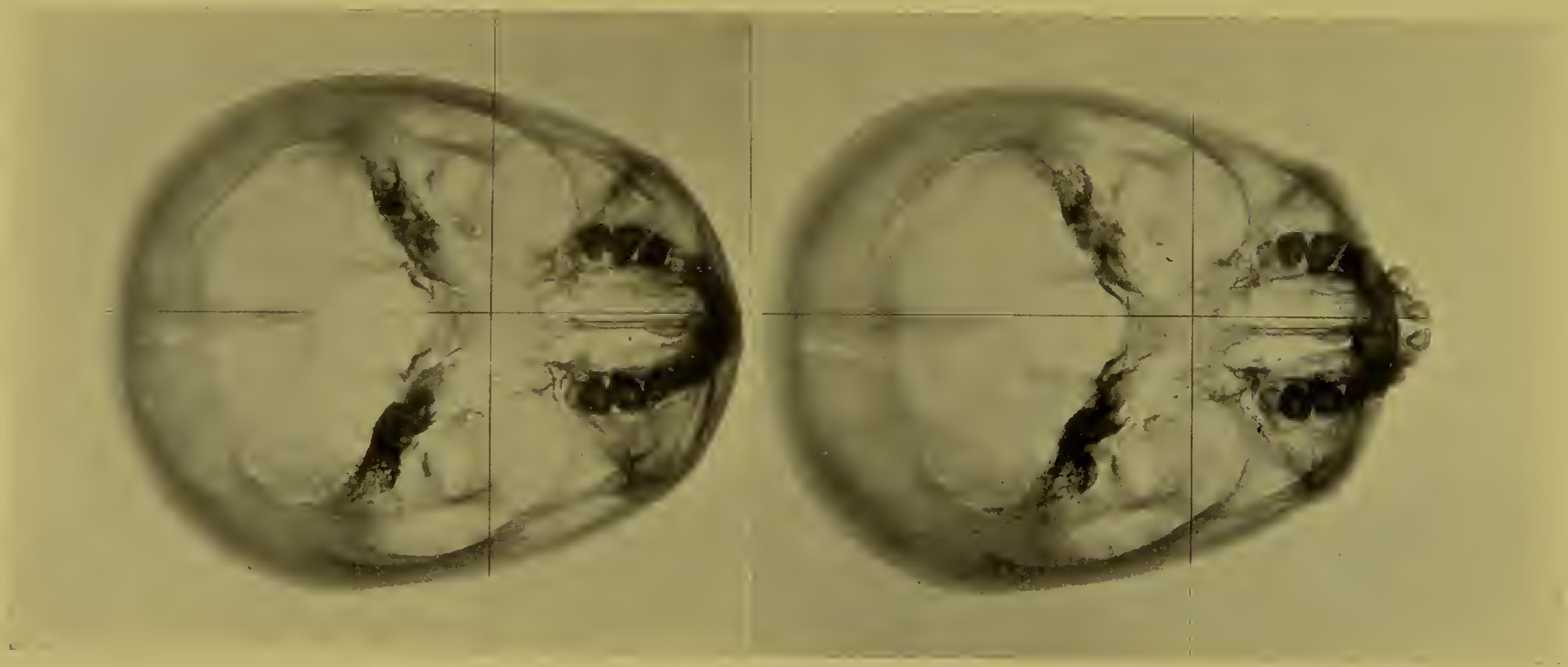
Fig. 11 shows a reduced stereoscopic radiogram of a lateral view of a skull.

FIG. 9.



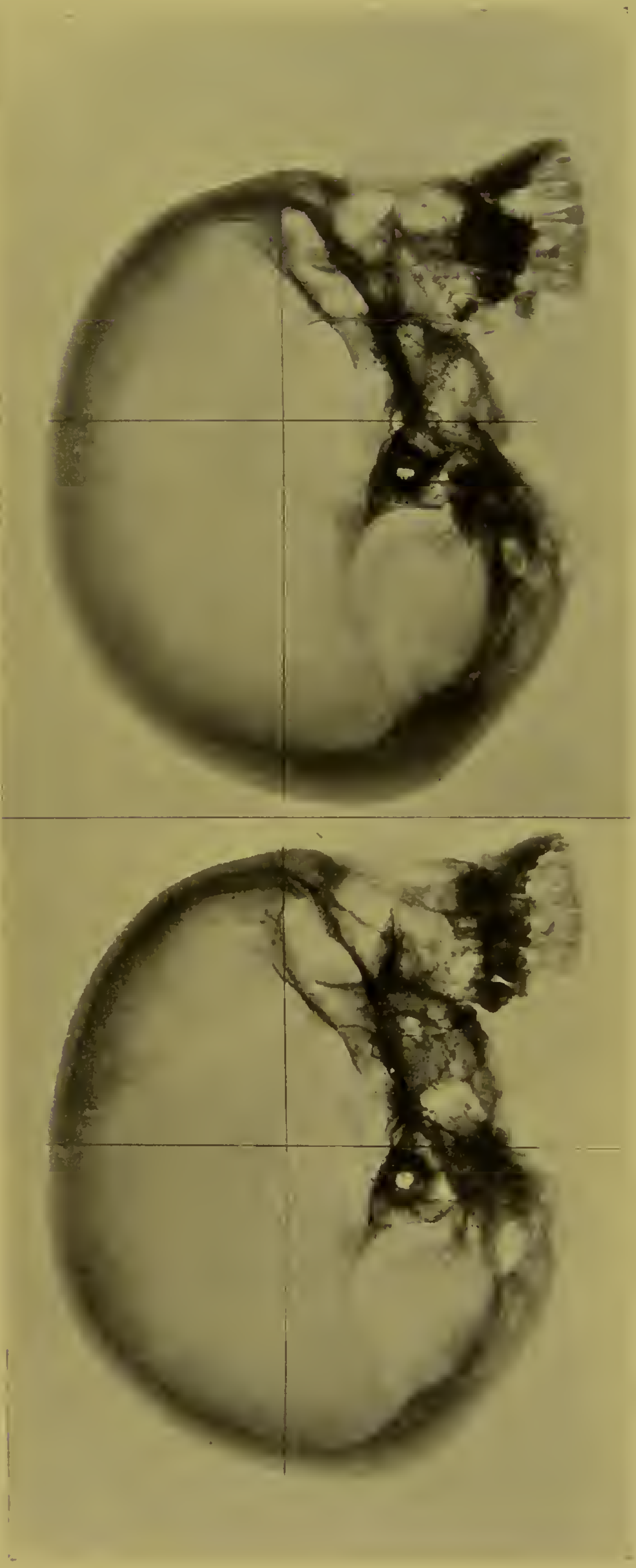
Stereoscopic radiogram. Vertical view from base of skull. (Examine with ordinary prism stereoscope.)

Fig 10.



Stereoscopic radiogram. Vertical view from vertex.

FIG. 11.



Stereoscopic radiogram. Side view.

The original was made by Dr. William S. Haughton of Dublin. In order to appreciate the true value of this picture it must be seen with a large reflecting stereoscope. Unfortunately such pictures cannot be observed conveniently upon the screen, therefore you are invited at your leisure to examine this and other radiograms with the stereoscope. Seen in this manner the skull stands out in bold relief, indicating the teeth and their pulp-cavities with their relative positions as they are held in the alveolar process. The upper third molars have been impacted and are resting on a line with the roof of the mouth. There is also an impacted upper premolar resting above the second premolar.

In an ordinary single X-ray picture it would be impossible to localize the true position of these teeth. A stereoscopic radiogram gives a very much better idea; two stereoscopic pictures taken at right angles with each other will locate correctly, especially if the stereographs are as well done as in this case. Unfortunately such a right-angle picture could not be taken of a living subject. The region of the maxillary sinuses is beautifully shown, and their respective walls can be outlined. The inner walls of the orbits, with the ethmoid cells resting between them, can be distinctly seen. The frontal sinuses are well shown, also the floor of the anterior fossa of the brain-case. In examining the center of the skull the right external auditory meatus is the nearest object. In looking through the squamous portion of the temporal bone the upper part of the petrous portion of the same bone is well defined. Looking through the skull to the opposite side of the brain-case the grooves for the meningeal arteries and the sutures of the brain-case are seen, and, near the base of the ridges, the petrous portion of the temporal bone of the opposite side. The density of the right petrous portion cuts off part of the view of the left internal auditory meatus. At the back of the petrous portion a deep groove is seen for the passage of the lateral sinus. Pages might be written describing what might be seen in this illustration.

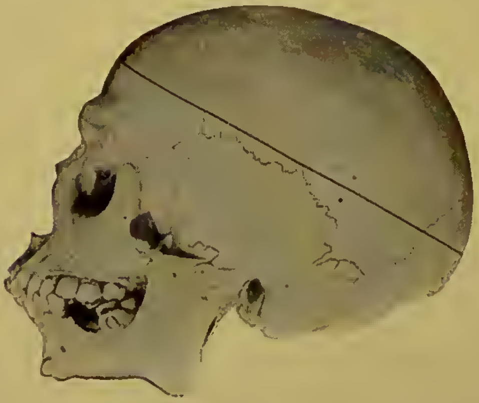
Fig. 9 is a vertical stereoscopic radiogram by Dr. Haughton, taken through the base of the same skull as Fig. 11. It is taken at right angles to the other picture. The occluding surfaces of the teeth are shown, also the two impacted upper third molars in line with the other teeth, and the impacted upper premolar is seen to be in a line with the second premolar. By comparing this figure with the last illustration the teeth can be located for all practical purposes. Two pictures taken at right angles to each other, when studied together, will indicate pretty accurately the correct position of any foreign body or impacted teeth. (Figs. 9 and 11 illustrate this point well in regard to the impacted upper teeth.) Along the center of the roof of the mouth are two lines showing the two plates forming the vomer and the other portions of the septum of the nose. There is a slight deviation of the septum opposite the space between the second premolars and the molars. The turbinated bones are seen through the roof of the mouth. Passing to the outside of the teeth and looking through the bone at the base of the malar bones and through the tissue surrounding the teeth, the maxillary sinus can be well defined. In passing back of the facial bones the internal structures of the body of the sphenoid bone, the basilar process of the occipital bone, and the petrous portion of the temporal bone can be studied.

Fig. 10 is from the same radiogram as Fig. 9, with the position of the halves changed. That originally on the right side is placed on the left one, and that which occupied the left side is here on the right side. It shows the floor of the three fossæ of the brain-case. The floor of the anterior fossa is somewhat indistinct on account of its thinness, which allowed the X ray to pass through it; but in so doing it reveals the ethmoid cells and the sphenoidal sinuses. The lesser wings of the sphenoid are seen posteriorly, also the petrous portion of the temporal bone. The mastoid cells are likewise visible.

CASE SHOWING THE VALUE OF X-RAY WORK.

The illustrations following will show the value of the radiogram in investigating. The case is that of a young man now nineteen years old, who fell off a banister when sliding down, at the age of four years, and injured the temporo-mandibular articulation, causing ankylosis of the joint. At ten years of age a double operation was performed for removing the condyloid process for the relief of the ankylosis, resulting in a slight improvement for a short time.

FIG. 12.



We have in this case a typical example of what the writer referred to in 1898 in describing the effect of permanent ankylosis on the bones affected; that is, that "the abnormal application of forces to the developing bone results in the development of an abnormal form." There is no question that in this case we have the typical abnormal bone as shown in Fig. 12.

Fig. 13 is from a photograph showing a profile view of the patient. Fig. 14 is a front view. Fig. 15 is a view showing the muscles of the anterior portion of the neck in an endeavor to open the mouth. Fig. 16 gives the lateral muscles of the neck during the same effort. The physiological action of these muscles can be studied from these last two pictures. Naturally the anatomist and surgeon would be anxious to know something about the changes that have taken place in the internal anatomy through the muscular action. With this idea in view two X-ray pictures were made, one from each side.

Fig. 17 is from a radiogram taken by Dr. Kassabian. It is made from the right side of the face, and shows that the mandible has changed completely, taking on the character of a typical ankylosed jaw; this process was demonstrated eight years ago, when the writer gave several illustrations demonstrating this point. This and other cases have confirmed the description and the cause as then given. The mental process is drawn back and the gonion downward. In this case the ramus is drawn back beyond a line parallel with the anterior portion of the vertebra. This may be partly due to the removal of the condyloid process in the surgical operation referred to. Through the loss of this process, with the action of the external pterygoid muscle, there is but little to prevent the whole bone from being forced backward, and when it goes back, the hyoid bone, the tongue, and all the tissues associated with it must move backward nearly to or against the post-pharyngeal wall.

FIG. 13.

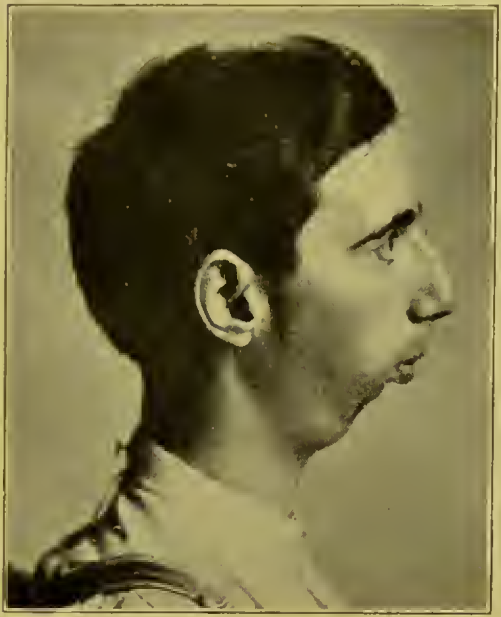


FIG. 14.

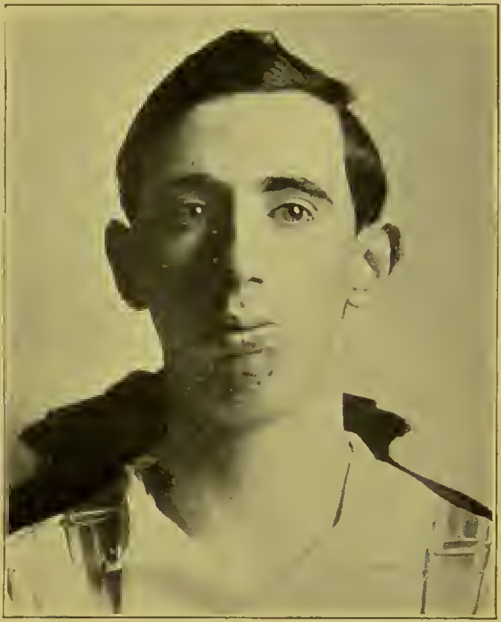


FIG. 15.

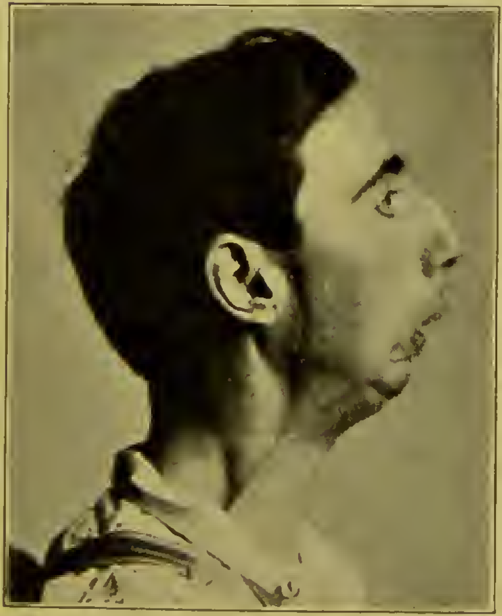
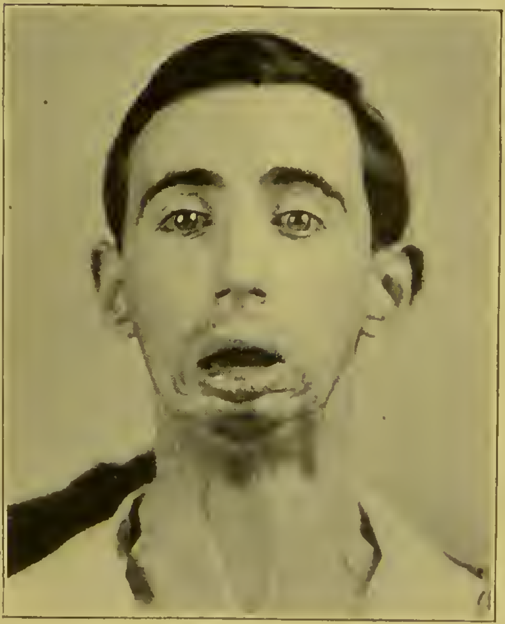


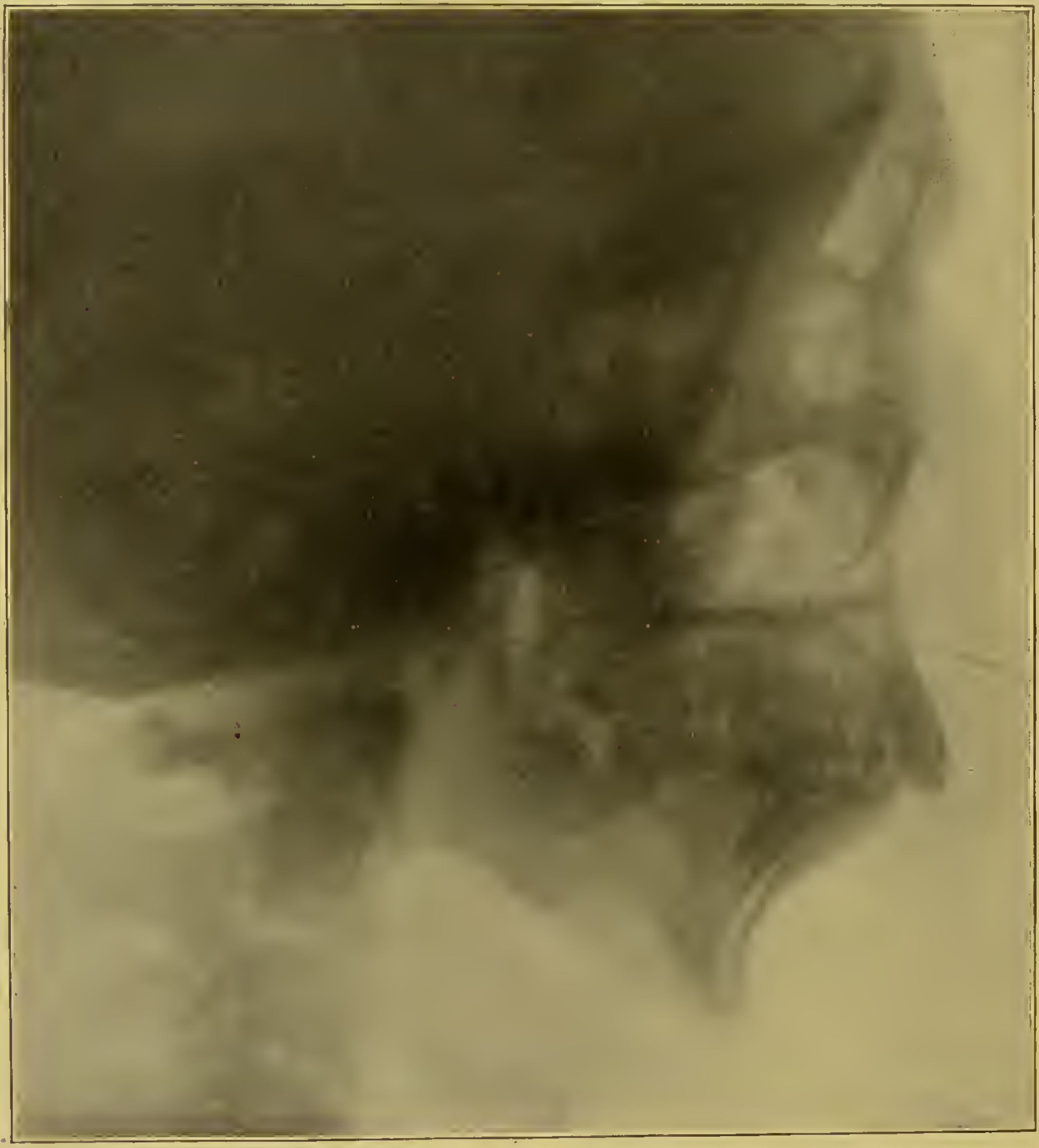
FIG. 16.



The picture also shows that the upper and lower third molars are impacted.

The shape and position of this side of the mandible are similar to those of the left side, although the teeth differ somewhat in their position in the lower jaw. The lower second molar is tilted forward, while the third is impacted. The dark line to be observed above the teeth in the illustration (Fig. 17) is the roof of the mouth seen edgewise, which makes it look dense. Above this dark line are the maxillary sinuses. The dark line over this is in part the floor of the orbits, above which, again, is the region of the ethmoid cells. The roof of the orbits is outlined, and above that again the frontal sinuses are clearly seen, showing a partial septum between them. From this picture alone it would not do to claim that there is no septum, as it is possible that it is there and, it being thin, the rays have passed through it. Until lately the writer was of the opinion that there was always a septum between the two frontal sinuses, but he has now in his possession two specimens without septa.

FIG. 17.



Radiographic pictures of dried skulls when shown by the stereoscope are all that can be asked for. But the surgeon will not be satisfied until the radiographer produces as good pictures from the living subject as those from the dried skulls. Sectionizing and the stereoscopic pictures have proved that no two skulls are alike in regard to the roots of the teeth, their shape or position. The pneumatic sinuses and cells also differ greatly; therefore, when trouble exists in these regions and the surgeon is about to operate he is anxious to know the special anatomy of the part to be operated upon, as a correct diagnosis is difficult without it. At such times the value of the X ray may be inestimable if the radiogram can be so perfected as to show density, shape, size, etc., in all their relations to the living subject. The writer is of the opinion that this knowledge will be obtained through the use of the stereoscopic radiogram. Those who are investigating along this line of work have accomplished a great deal during the past eight years, since the discovery of the penetrating powers of the X ray, but it is improbable that they have yet attained the limit.

Discussion.

Dr. E. B. Lodge, Cleveland, Ohio. For the past year I have been doing some skiagraphic work along this line, but my work has been largely with reference to the regions of the maxillæ and teeth.

I have found the X ray invaluable for impacted third molars and for locating the dependent parts of antra and for all manner of abscesses, foreign bodies within the pulp-canals of teeth, and so on. I regret that I am not able to discuss this paper in the way it is worthy of, but I want to say that I thank Dr. Cryer and that I have been a very appreciative listener.

Dr. L. E. Custer, Dayton, Ohio. Dr. Cryer has not only shown us something new in X ray, but has also shown us a thing of great importance in the study of anatomy. The X ray is the only means whereby we can get the exact relation of many of the parts of the human being in life. The movements of the mandible in its articular seat can be clearly shown. We also see by an inspection of the pictures of young subjects that the apices of the uncompleted roots have a marked bell-shape appearance, and it would seem that later on there is a folding in of the apex even to the extent of constricting the canal at this point.

Dr. Cryer has been accused of being a little tardy in recognizing the value of the X ray in dental diagnosis, yet I think this presentation, which is so highly creditable, is an ample reward to the profession. The use of stereoscopic X-ray pictures is of great value, and I think it will not be long until extensive use will be made of this method of examination.

Dr. R. Ottolengui, New York, N. Y. I have been exceedingly impressed by certain aspects of this paper. It is useless for me to make any comment on the value of this method in diagnosis, because that is a self-evident proposition. I therefore restrict my remarks to what seems to me to be the remarkable advance that has been made in the making of these pictures over what we might call the beginnings of things which are such a short distance back in the past. And in order that we may more fully appreciate this I want to say one thing about photography. It is fully half a century since photography was first introduced, and the first statement that Daguerre made was that he could expose a plate with his apparatus, and if the object against which it was aimed was brilliantly lighted he could obtain a picture of it in five hours. That was the beginning of photography. Today we take pictures of the most rapidly moving objects. The most wonderful evidence of this that I have seen was a picture taken of a boatload of men from a war-ship rowing, and the picture was so instantaneous that the individual drops of water in the spray from the oars could be seen. The rapidity of the time required for that picture is almost inconceivable.

Now in X-ray work I wish to call attention to the fact that while people think of this as a photographic process, it is not strictly speaking a photographic process, because no lens is used, and because no negative is made. Someone recently made a mistake in one of the latest numbers of the *Cosmos* in saying that a picture in white was a negative X ray. As a matter of fact the very first impression that is made, whether it be on a film or on a piece of sensitized paper which is put in with the film, is a positive, not a negative, because it is what might be called a shadowgraph. In other words it is a mere printing process, just as you put a negative against a piece of sensitized paper, and pass the sun through the negative and make your print. In this instance, in place of the negative, a part of the human body is used. The plate is placed against it and the light is passed through it and you make the print, and what you see as a result is a positive. So that gentleman made a mistake when he called it a negative. When he showed his picture with the bones white he had reversed the process.

Now that being the case, and remembering that this work is done without the aid of lenses, all who have looked into photography and who know the difficulty of getting stereoscopic effects with the aid of lenses, will be able to imagine the difficulty of obtaining these stereoscopic effects by this apparatus without the aid of lenses. I assume that these pictures shown here today were taken without lenses.

Dr. CRYER. No lenses were used. The pictures are nothing more than shadow pictures.

Dr. OTTOLENGUI. They are mere shadowgraphs; yet by some ingenious arrangement of the instrument with which you look at them, and of the method of taking the two at one time—

Dr. CRYER. No, the two were taken at separate times.

Dr. OTTOLENGUI. That is even more wonderful. By this means Dr. Cryer has obtained these remarkable stereoscopic pictures.

Now, why is a stereoscopic picture of more importance than the flat print? Because it gives you the absolute relations of things. In the ordinary X-ray picture, one object which is behind another offers the same amount of density, the same resistance to the passage of the ray, whether the object which we are seeking be in front or behind, and in many instances it is exceedingly important to know whether it is in front or behind. It is only by this stereoscopic effect that this can be known. I have in mind a particular case where the X-ray picture was of little value, because it could not be determined which of two objects seen was in front and which behind. This was a case where a tooth was missing in the front of the mouth, and when the X-ray search was made, the picture, very much to the astonishment of the investigators, disclosed an additional supernumerary tooth in the jaw. The question arose whether it was labially placed or palatally placed; this knowledge was needed in order to drill for it and remove it. Nothing but a stereoscopic picture could have disclosed that fact.

Now, I believe that just as photographic processes have changed so that, instead of five hours being necessary, one two-thousandth of a second is a sufficient length of time to obtain a photographic impression upon the plate, so there is reason to hope for great improvement in the making of X-ray pictures. In eight years there has been so much progress that we can now obtain a stereoscopic picture from a dry skull, and this progress gives us abundant reason to hope that we may in a very short time have stereoscopic pictures from the living subject.

I have seen a great many pictures, lateral views of full skulls, and diagnosis has nearly always been obscure in those cases because they have been taken in such a plane that the sides of the jaws have been nearly one over the other. It is a noteworthy fact that in the pictures shown here by Dr. Cryer, by having the mouth opened the pictures have been taken in such a way as to show a large curve, and you can see the opposite side of the jaws. They are in that particular the most remarkable radiographs that I have seen. That shows that another possibility has been discovered—namely, the taking of pictures from one side of the head and showing the opposite side of the skull as clearly as the front side.

I think Dr. Cryer has given us a remarkably interesting paper, and I wish to express to him my appreciation of it.

Dr. CRYER (closing the discussion). I have little to add to the discussion except that I might mention the fact that stereoscopic radiograms are made by exposing two plates separately in order to obtain accurate views of both sides of the object to be radiographed. The technique consists in placing the plates upon a table constructed for the purpose, the surface of which is outlined to correspond to the sizes of radiographic plates. A sliding board in the under surface carries the plate to its proper position and it is so arranged that each plate will bear the same relation to the object to be radiographed. The object being placed on the table at a point to correspond to its center is now ready for one of the exposures. The tube is suspended above and to the right of the center at about one and one-half inches. After this view is exposed the light is shut off, the plate is removed and substituted by plate two, the tube is moved to a corresponding position on the left, and the second exposure is made. The two seen in combination cause the stereoscopic effect which has been shown in the large stereoscope. It is not only shown in the large stereoscope, but can be shown in the ordinary small stereoscope when reduced to proper size.

In showing the picture today I have two prints taken through the vertical position of the skull. In examining the pictures in one position we look through the foramen magnum, or the base of the skull, up into the upper portion of the skull. Then by reversing the pictures we have a view of the skull from the crown down through to the base.

I do not claim anything original in regard to the pictures I have shown. They have been worked out for some time by others both in Europe and in this country. Credit is due to so many that it would be impracticable to give their names; I will simply say that in the books on X-ray work the stereoscopic X-ray work is fully described, together with the names of the originators. I must add here that great assistance has been rendered me in producing these pictures by Dr. Kassabian of the Philadelphia Hospital.

Dr. Ottolengui spoke of the pictures of the dried skulls. The last two pictures I showed were of living skulls. While conversing with a rhinologist in Europe, after showing him many of my specimens, indicating various shapes and sizes of the frontal sinuses, he said: "These specimens are interesting, but to the surgeon they do not give any idea of the anatomy of the person to be operated upon." The last picture on the screen showed the frontal sinuses so plainly that if a fluid were there it could be detected, and if a dark line were running horizontally through that picture, all that would be necessary would be to put the patient on his back and take another X-ray picture, and you would get another view of that fluid at a different level. In that way a correct diagnosis could be made.

Dr. A. F. Sonntag, Waco, Tex. I wish to ask Dr. Cryer a question. What is the safe method when applying the X ray to the head so extensively as is required to obtain a perfect radiograph? Have you had any bad results?

Dr. Cryer. In my work in connection with Dr. Kassabian we have not met, in the last two years, with any bad effects—such troubles as burning of the face, or other injuries, destruction of the hair follicles and the like, where one exposure after another has been made. Every part of the body that is not to be X-rayed should be protected by sheets of lead, say "tea lead." It should be bent over the shoulder, and if you want only the face, you should cover and protect the head and hair. It is well to remember that in making radiographs of the head the exposure should be very much longer than in the case of the hand or chest. The bones of the head are dense, and so a longer time is required. But I do not believe any bad effect will follow the judicious use of the X ray, especially when the other parts are protected as I have already indicated.

Dr. Sonntag. The reason I mentioned it is that I had occasion to see a very serious case something like a year and a half ago. A gentleman, not a practitioner of dentistry or of medicine, who has made X-ray work a specialty in connection with the University of Texas, in making an experiment on himself, received a very serious burn on his arm. He had been using the X rays extensively on other persons without having any bad results, but in using them on himself he had a very serious case.

Dr. Ottolengui. I think the men who are using the X ray now feel perfectly safe, because they have much more powerful apparatus, which allows the exposure to be very much briefer. Then they have perfect methods of insulating and protecting all the parts except where the work is being done. It is simply a question of using sufficient power to make short work of it, and then not to repeat the operation too frequently. Dr. Price recently showed that the operator should protect himself in this work, because he is constantly putting his hands close to the light; and he now has a glove which he wears which is thoroughly protective and yet elastic enough to enable him to work. I have no doubt that similar bandages for the entire body could be made of this same material.

The following paper by Dr. W. T. ECKLEY, Chicago, Ill., was read by title.

Phylogenetic Evidence Bearing on the Function of the Accessory Sinuses in Man and the Higher Vertebrates.

By W. T. ECKLEY, D.D.S., Chicago, Ill.

THE accessory sinuses of the nose belong to a system of pneumatic conduits in animals, and subserve, severally, buoyancy in fishes, olfaction in amphibians, and subsidiary respiration in birds and mammals. Piscine air-bladders, avian pneumatic bones, the accessory nasal chambers in the amphibia, and the mammalian air-sinuses are, then, in reality individual links, differing materially among themselves in size and location, but collectively forming an all-important pneumatic chain connecting racially the vertebrate kingdom and extending upward from the simple true fish to composite man.

The link of the pneumatic chain in homo sapiens has, however, become so profoundly modified by circumstances as to make its functional elucidation unsatisfactory in the extreme without comparative study. The object of this paper, then, is the adduction of phylogenetic evidence looking to the establishment on the broadest possible grounds of the function of the accessory sinuses in man.

In anticipation of proof for the assumption let it suffice for the present that the accessory air-sinuses in man and the higher vertebrates are—(*a*) local organs subsidiary in their action to the lungs in the aeration of the blood; (*b*) obsolete olfactory organs in the entire vertebrate kingdom save alone in the cetaceans.

In birds of flight the wing-bones contain air-cells which communicate with the lungs through air-sacs in the neck, thorax, abdomen, pelvis, and intermuscular spaces. This air, according to Hunter, renders the body specifically lighter, aids mechanically in the action of the lungs, and purifies the blood as does air in the swim-bladder of the fish or in the lung of man. Furthermore, the quantity of air admitted to the bones is proportionate to the rapidity and continuance of the bird's flight, and is distributed to those members most employed in locomotion; hence, the wing-bones of the owl and the femur of the ostrich enjoy superior pneumatic qualities.

During tranquillity pulmonary aeration in owl and ostrich suffices; when, however, extraordinary flight demands an increased amount of oxygenated blood, a subsidiary respiratory system located in the bones of the most active parts is called into use. Hence the pneumatic cells found in the wing of the owl, and those in the femur of the ostrich, are local respiratory organs of these animals.

Reduced to its simplest terms, the extent of pneumatic bone areas is directly proportional to the demands of respiration, and differs markedly in different species of animals. As all birds are not dependent on extreme flight by wing or leg, it logically follows that some birds have less extensive pneumatic bone areas. Maximal and minimal pneumatic respiratory expedients in birds depend on the local demand for oxygen, and just as the swim-bladder in fishes depends for its size and usefulness on the local requirements of the animal, so too the number of pneumatic bones in birds is dependent upon the analogous requirements.

Terrestrial animals among mammals possess an abbreviated pneumatic system of bones, similar in structure, development, and function to the pneumatic bones of birds, differing from these only in location and extent. The mammalian pneumatic bones are those of the head; the avian, those of the extremities. Each is produced by evagination from a primary respiratory organ. Each consists of bony and membranous parts. Each has an extensive capillary field. Each is located in an area capable of great local activity. Each derives its nerve and blood supply from the same source as that of the region in which it is located. Each is a local subsidiary respiratory organ, called in birds pneumatic bones, in man the accessory nasal sinuses.

Reduced to a general proposition, a subsidiary respiratory system as found in pneumatic bones contemplates bones containing air in free communication with a primary respiratory organ. The number of pneumatic bones may be great or small as determined by the exigencies of the case. The bones possessing these pneumatic qualities may occupy the head or extremities. The animal possessing such respiratory expedients may inhabit air, earth, or water. When primary respiratory air-passages send air-containing processes into bone, the region thus invaded is always one of vital functional importance to the animal, and the pneumatic cells in its midst are, in man as in aves, to be regarded as local respiratory organs.

In those domestic animals on which commerce depends for foodstuffs and draft, the pneumatic bones are cranial. Truistic, indeed, were any reference to the important subsidiary rôle played by the same in the local aeration of blood in the distribution of the internal maxillary artery. No body of scientists in these days is more conversant with the enormous activity exerted by the muscles of mastication during grazing, mastication, and ruminating, than the one I am now addressing. Can anyone accepting the doctrines of Owen and Hunter relative to local respiration in the femur of the ostrich, logically deny the utility of the similar function of the immense air-sinuses in the vicinity of the muscles and bones of mastication in the domestic herbivorous animals? There is not the least doubt that *bos domesticus* during one hour of quiet rumination exerts a greater number of foot-pounds of muscular energy than does the ostrich in a podalic stunt of the same duration.

In the elephant, with an instinct superior to that of our domestic animals, with an immense proboscis for various necessary purposes, with enormous muscles of mastication, all the bones of the head are pneumatic, and significant indeed from a scientific standpoint is the tradition among the Singhalese that sinus disease among a herd of elephants is a divine visitation.

The pneumatic bones of man are confined to the head and are variously designated cell sinuses and antra, a nomenclature founded rather on a difference in size than on inherent structural peculiaritics, for they are similar in location, development, nutrition, and liability to disease. The sinuses in man as well as in the lower animals are derived from the nose by evagination, hence their ectodermic epithelia partake of the nature of the nose.

In man the sinuses occur in the maxilla, in the frontal, ethmoidal, and sphenoidal bones—admitting of gcneral, not of specific limitations. They are variable in size in different races and in people of the same race; even in the same individual the sinuses of the two sides may differ.

In conformity with a general biologic rule, the openings of a sinus may occur double—reminding one in this regard of a double ureter for a single kidney; and indeed they present the widest variance in size within physiologic range. The possible disparity in number and size of the openings rests on an embryologic law, immutable and time-honored.

Except in the most general skeletal way sex docs not exert influence on the sinuses, and I am slow to bclieve that post-mortems and clinical experience will ever justify the statement that the floor of the antrum in women is above, in men below, the floor of the nose.

The sinuses in man are tardy in appearing, and with no demonstrable reason develop *pari passu* with the generative organs. Just as the male and female conduits announce their completed canalization by semination and ovulation respectively, so do the sinuses announce their completion by adult qualities of voice.

The simplest olfactory organ in all true fishes is a single paired ectodermic depression above the mouth. The most highly specialized organs of smell in fishes consist of a spindle of neuro-epithelial cells, with an independent disconnected sac, foreshadowing the sinus system in the higher vertebrates.

In the amphibia the accessory nasal chamber, homologous with the maxillary sinus of all vertebrates, contains a part of the olfactory organ, hence in man the maxillary sinus may be considered as a phylogenetic olfactory organ, although functionally obsolete. In the amphibia the olfactory organ divides into a nasal part and an accessory nasal chamber. In some cases these two parts are entirely separated and each has its own olfactory nerves. "There can be no doubt," says Wiedersheim, "that the accessory nasal chamber of the amphibians is homologous with the maxillary sinus of all vertebrates. In no other vertebrates, however, does it retain the character of a kind of separate nasal chamber, but on the contrary the higher we pass in the vertebrate series, the more does the maxillary sinus become separated physiologically from the olfactory organ; it loses its olfactory epithelia and finally degenerates into a simple air-sinus."

Owen's statement regarding the distribution of air to organs proportionate to their activity has a cogent application to the sinus system of terrestrial vertebrates, including men of course. In these the active parts are the brain and the muscles of mastication in the immediate vicinity of immense sinuses. Blood from the respiratory field of sinuses and from the mandibular region reaches the pterygoid plexus, and this latter communicates with the sinuses of the dura mater by emissary veins. As previously shown, the sinuses furnish a capillary field for the local aeration of blood supplying the muscles and bones of mastication, just as the wing-bone of the owl or the femur of the ostrich receive blood for aeration proportionate to the rapidity and continuance of flight.

We have made an endeavor to draw logical conclusions looking to the establishment of the rôle played by the accessory sinuses in man and the higher vertebrates. That the pneumatic bones of the head in mammals are functionally analogous to those in the extremities of birds can scarcely be denied, since by location they are in a region where aeration of the blood is a local necessity; hence we conclude that the sinuses in man are to be regarded as local respiratory organs principally for the brain and the muscles of mastication. It is generally conceded that the frontal, ethmoidal, and sphenoidal sinuses are genetically related to the antrum. In one class of vertebrates only, the amphibia—on the authority of Wiedersheim—does the maxillary sinus serve as an olfactory organ; hence we conclude that in man this sinus is to be regarded as an obsolete phylogenetic olfactory organ.

In addition to the function previously cited, secondary ones may be divined. In the amphibia the accessory nasal chamber, homologous with the maxillary sinus of all vertebrates, contains a part of the olfactory organ, hence in man the antrum may be considered a phylogenetic olfactory organ.

In birds and mammals at an early stage, prior to demands for local subsidiary organs of respiration, bones are wanting in pneumatic qualities. In adult birds the sinuses impart tone and strength to song, hence as a mating factor in birds the sinuses are subsidiary to procreation.

In man the sinuses prior to puberty are in an undeveloped state. Puberty in man is the phylogenetic "period of mating" in the lower animals. The unstable voice of youth as well as the so-called nasal character of the voice in diseased sinuses seems to confirm these latter as subsidiary vocal organs.

The sinuses in birds and mammals develop *pari passu* with the generative organs. Prior to the completion of this strange duality the lower animals remain unmated units, the higher animals are unconscious of their sex. Orators and vocalists are functionally at their worst when the sinuses are diseased; hence the simultaneity in development of sinus and generative organs is more than coincidental, and should suggest the solution of a problem looking to the reciprocal influence on their respective organs, of disease and surgical operations.

In their development the higher vertebrates pass through transitory stages which in the lower animals become fixed structural characters. As a diagnostic expedient, early recognition of structural departure from the normal in man is desirable. In the floor of the antrum of man an elevation of variable height, producing antral pockets, represents in the horse a permanent partition separating the anterior from the posterior antrum. Conchal sinuses, occasionally encountered in man, are permanent in the horse; while in man an accessory ostium maxillare into a conchal sinus is simply a reversion to a fixed structural character in the ox and horse. Those rare instances of palatal and lacrymal sinuses and bulla ethmoidalis communicating with the antrum of Highmore are survivals of a constant condition in *bos domesticus;* likewise survive in the sinuses of higher vertebrates those trabeculæ which in the pneumatic bones of birds give strength and stability.

Looking to the greatest conservatism in the dental art—for dentistry in its most expanded aspect is more than mere local treatment—there is almost an infinite field of usefulness associated with the proper care of the dentures and the intimately associated accessory sinuses of the nose. Unnecessary pain produced by broach or dam necessarily reacts reflexly on the lining of the sinus, for their nerve supply is from the trifacial. In the words of McNeal on the domestic animals, "Infection of one sinus means infection for all." The same is true of the sinus in man. In view of their liability the functions of these pneumatic bones should be borne in mind by the operator.

CONCLUSIONS.

1. The sinuses in man are phylogenetically very ancient structures and are analogous to the air-cells in the pneumatic bones of birds of flight.

2. The function of the sinuses is twofold: (*a*) Local respiratory and subsidiary to the lungs; (*b*) The maxillary sinus in the higher vertebrates is phylogenetically an organ of smell, having its prototype in the accessory nasal chamber of the amphibian.

3. For unaccountable reasons the sinuses develop *pari passu* with the generative organs.

4. The variations are so great as to make classification looking to definite size and shape impossible, and for embryologic reasons each sinus is a law unto itself.

On motion of Dr. Ottolengui, seconded by Dr. Hough, the following papers were also read by title:

Some Anomalies of the Hard Dental Tissues.

By A. HOPEWELL-SMITH, M.R.C.S., L.R.C.P., L.D.S., Eng.,

LECTURER ON DENTAL ANATOMY AND PHYSIOLOGY, AND ASSISTANT DENTAL SURGEON AT THE ROYAL DENTAL HOSPITAL OF LONDON.

In the following communication I have pleasure in submitting to the congress a few brief notes on several rare pathological conditions of the enamel and dentin of the teeth of man. They are isolated cases, and so far as it is possible to judge are unlikely very soon to be pluralized.

The question of the value of examining and putting on record solitary instances such as those about to be described is one of some importance. Facts are best deduced from a great number of observations, every side of a subject being scrutinized and utilized in all its aspects; incontrovertible proof is most surely obtained from the work of many years and as the outcome of the examination of much material.

It sometimes happens, however, that opportunities arise for the investigation of curious irregular conditions which are seldom met with. A study of such is, however, not valueless, but may by its very obscurity and very rarity serve two purposes. First, it may be possible at times to find that light is unexpectedly but clearly thrown on normal physiological but not easily understood problems; and second, the sum of our knowledge of the workings of the forces of disease may be enlarged, and consequently the guiding principles of prophylaxis or treatment distinctly benefited. On the other hand, it is possible that partly understood processes—physiological or pathological, as the case may be—may be rendered even more complex and leave the mind in a more chaotic state than before. It is to be hoped, however, that that will not be so in this instance.

The processes of calcification of enamel, dentin, and cementum are defined with some considerable difficulty, and the problems relating to absorption of the hard tissues do not admit of an easy solution. It may be found useful at some distant date to recall the extraordinary appearances presented by the following studies.

DUPLICATION OF THE PULP-CAVITY.

An upper first permanent incisor was removed from the mouth of a young adult for the purpose of relieving the crowding of the anterior teeth. It was apparently sound, save for a longitudinal depression on the mesial aspect of the crown. On preparation and staining it was found to possess two pulp-cavities, each free at the distal extremity but united toward the radicular portion of the neck of the tooth. The smaller cavity was situated on the lingual side. A median vertical section showed that the enamel and dentin of the labial surface was practically normal. But the lingual side displayed several interesting and unique pathological conditions.

The enamel was much thickened in amount—there was what one might term hyperplasia of this tissue. It was, moreover, of poor construction, imperfectly calcified in places, but free from caries or external or internal absorption. It colored vicariously and in patches only by the borax-carmine stain.

Projecting into this thickened enamel, and close to the primary pulp-cavity, was the subsidiary pulp-chamber, whose surface was smooth and did not present the foveolæ of Howship. A thin narrow spur of well-formed dentin, similarly unabsorbed, intervened between it and the free surface of the tooth. Nowhere did the dentin show signs of absorption. It was, generally speaking, fully developed, the tubes ending in the usual manner and extending in the usual direction. The pulp tissue was not well preserved, but fragments exhibited nothing abnormal in its structure.

It is not at all an easy matter to decide as to the method of the formation of the second pulp-chamber. It is possibly due to segmentation or invagination of the enamel organ on the tongue side of the tooth-germ, and dichotomy of the dentinal papilla in the corresponding situation. Had the process continued to a completer stage, there would probably have been found a true gemination of the tooth, by the budding off of a smaller caniniform structure on the inner side.

The invagination of the epithelial tissues might be accounted for by the mutual pressure of large teeth-germs in a small dental arch.

Undoubtedly, had it been necessary to drill into the crown with a bur on the engine, the enamel would have easily snapped off and exposed the pulp in one or both chambers—an element of danger never to be forgotten in the preparation of cavities during the obturation treatment of dental caries.

FALSE PULP-NODULE.

Suppose this carious process had applied to the root portions of the dentinal germ, a condition such as is exemplified in specimens similar to the next to be described would assuredly be noted. Here the anomaly is in the root; in the case just described it was in the crown. For a section showing this irregularity the writer is indebted to the courtesy of Mr. Leslie Hodges, D.D.S., of Birkenhead, who sent him a section of an upper second premolar.

At first sight it would appear that a large pulp-nodule *in situ* was the only pathological change; but this is not so. Attached to one side of the root-canal, and deflecting the pulp from its usual course and position, was a large oval structure of dentin, having a kernel composed of osseous tissue and soft material containing bloodvessels. It soon became obvious, however, that the center of this adventitious body, which must be considered to be a developmental defect, was a compromise between compact bone and hyperplasic cementum. The lamellæ of properly constituted Haversian systems of the former were absent; the grossly exaggerated lacunæ of the latter were present in a multitude of shapes and sizes. The chief point was the enlarged width of the granular layer of Tomes, with larger spaces than usual. In this respect the periphery of the new structure corresponded very closely with that upon the external part of the cementum, with which it was most probably in direct and continuous communication.

The condition might have been produced by the invagination of a piece of the inner wall of the dental follicle or periodontal membrane, and its inclusion and full development when *in situ*. Precisely how this has been occasioned it is impossible to say. The epithelial sheath of Hertwig—a prolongation downward and then upward of the layer of cells of the internal epithelium of the enamel organ—may, during its formation of the shape of the root, have undergone a spur-like budding, which, projecting inward, produces the appearance noted. At all events this is an example of another obstruction to be met with at times in the root-canals of teeth, and one which makes the total extirpation of a pulp a remarkably difficult if not impossible operation to perform.

ABSORPTION OF ENAMEL AND DENTIN.

The last case to be described presents a most rare and extraordinary condition of absorption of the hard tissues. A mandibular third molar whose external configuration was of a more or less normal character, was divided several times in a vertical direction to ascertain the structure of an osseous mass situated securely on the exposed surface of the crown. After staining with Weil's process it was found that not only had the greater part of the enamel been removed by some obscure pathological process and compact bone deposited in its place, but that the greater part of the dentin was similarly affected.

In one place the amelo-dentinal junction was not only invaded, but the underlying dentin had been removed to such an extent that only a thin layer of hard normal tissue intervened between the pulp and the amelo-dentinal junction. The spaces were thus occupied by a mass of well-formed bone, lacunæ with their bone corpuscles and canaliculi everywhere predominating, and extending as trabeculæ in all directions. The intervening soft tissue presented nothing of a definite structure, as the soft parts had not been retained in their fresh state in physiological relationship to the bone or dentin. It is impossible for enamel or dentin or cementum to become inflamed—their anatomical peculiarities absolutely preclude this—and it is very difficult at first sight to explain the presence of the new adventitious tissue in this situation. Speaking with all reserve, however, it may be that an inflammation of the dental follicle has occurred. Osteoclasts, acting for some long period, had brought about absorption of the enamel surface, more and more of the tissue became removed, and presently the dentin was reached. The pathological work was more rapidly conducted in the latter, because of the ease with which tubular tissue can be absorbed.

Simultaneously with the inward march of an army of osteoclasts came multitudes of osteoblasts and soft tissue freely vascularized from the dental follicle; and the result was a repairing of the breach by the production of true bone. That there had been some inflammatory changes in the periodontal membrane and dental follicle was evidenced by the enormous hyperplasia of the cementum, which in one of the sections extended some considerable distance over the enamel margin. The cementum itself was very lacunated and quite abnormal in character.

It is again obvious that in the operative treatment of such a tooth, a bur on the engine, no matter how lightly used, would suddenly and without warning plunge into the pulp-cavity and expose the surface of that organ.

RECAPITULATION AND SIGNIFICANCE.

All these cases—of the frequency of occurrence of which one is unable to form any opinion—point to the fact that should always be borne in mind when excavating carious cavities in enamel or dentin and using the dental engine, viz, that curious developmental and acquired defects of these tissues that in themselves are absolutely outside the realm of diagnosis may exist. And extreme care should ever be exercised in the treatment of cavities, lest any such condition as described should, unwittingly on the part of the operator but none the less disastrously, be suddenly and inexplicably discovered.

Is There Uncalcified Tissue in the Enamel?

By DOUGLAS E. CAUSH, L.D.S.I., Brighton, Eng.

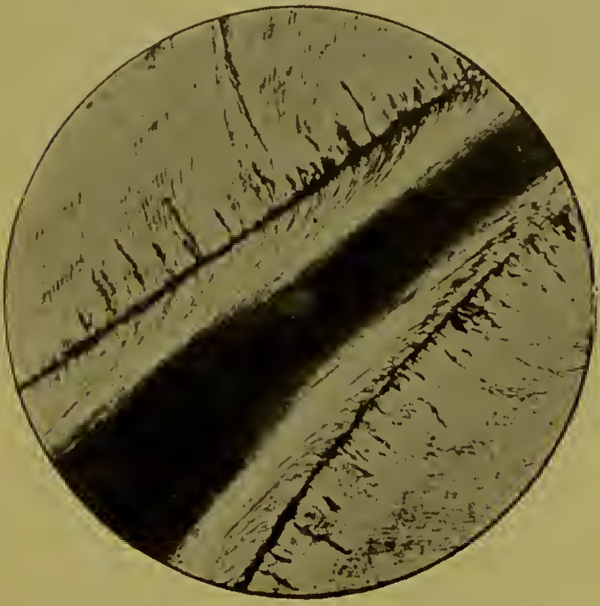
In discussing this question, "Is there uncalcified tissue in the enamel?" we are going over ground that has previously been much discussed; yet I think there is still matter for thought, and the paper, being the result of some original work, will, I trust, prove acceptable to you.

In England, Chas. Tomes, Leon Williams, and many others, deny the existence of uncalcified tissue in this structure. On the continent of Europe there is a difference of opinion, some denying, whilst others strongly affirm, that uncalcified tissue does exist in the enamel. In America there is also a diversity of opinion, and we have, as a consequence, the greatest difficulty in arriving at any definite conclusion upon this important subject.

At the present time all writers are agreed that the enamel is developed from the epiblast, and that this, in the early stages of development, consists of nothing but uncalcified tissue; as the development proceeds, a portion of this tissue becomes calcified, and with the commencement of the calcification the difference of opinions begin.

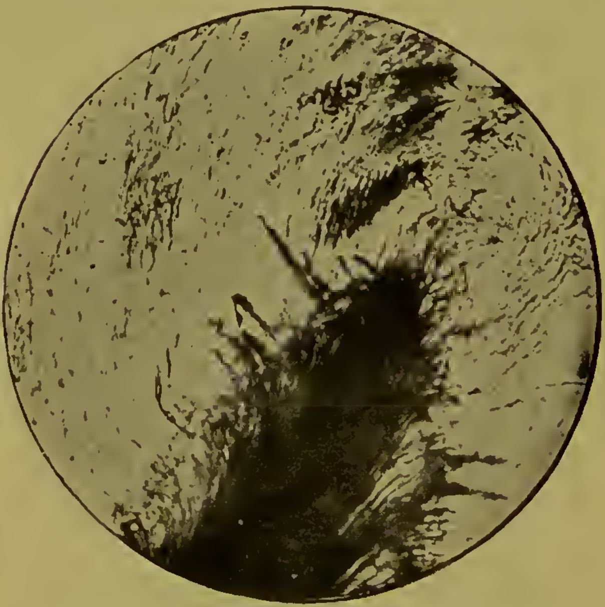
Most English writers state that the calcification of this tissue is so perfect that the whole of the enamel is eventually composed of nothing but inorganic salts and water; but, at the same time, they do not satisfactorily state what becomes of the original uncalcified matrix.

FIG. 1.



Section of incisor, showing stained enamel spindles and stained tissue between the prisms. (Magnified 100 diameters.)*

FIG. 2.



Spindles. (Magnified 200 diameters.)

Some writers, to confirm their theories, rely upon the chemical composition of the enamel as shown by an analysis of this substance; but, unfortunately for their theories, no two analyses of this tissue give the same results, and owing to this difference any dependence upon a given analysis is not possible. I have therefore, in my endeavor to unravel some of the mysteries of this complicated problem, devoted my attention to the microscopical aspect of this subject, and by special methods of staining have sought to obtain some light on Nature's work with this tissue.

The photomicrographs illustrating this paper are from sections of teeth stained by special processes about to be described, so that any who are interested in this matter can prove for themselves the theories advanced; whilst the deductions drawn are from the microscopical examination of some hundreds of sections of teeth, both of man and animals, that have been prepared for this purpose.

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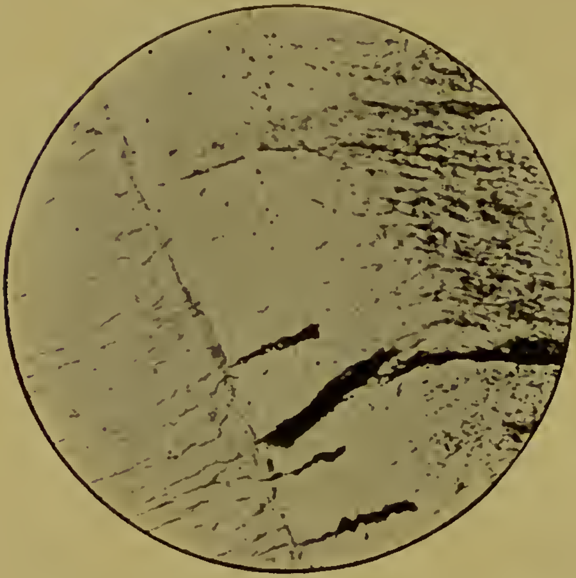
*[The original photomicrographs have been reduced one-third in the process of reproduction.—ED.]

My attention was first drawn to this subject by watching the action of copper amalgam upon the enamel. I noticed that the enamel of dead teeth always stained more than the enamel of those teeth in which the pulp was alive, and concluded that if the enamel contained no uncalcified tissue this should not have been the case, as in perfectly calcified tissue there should be no action by the filling except upon the exposed surface.

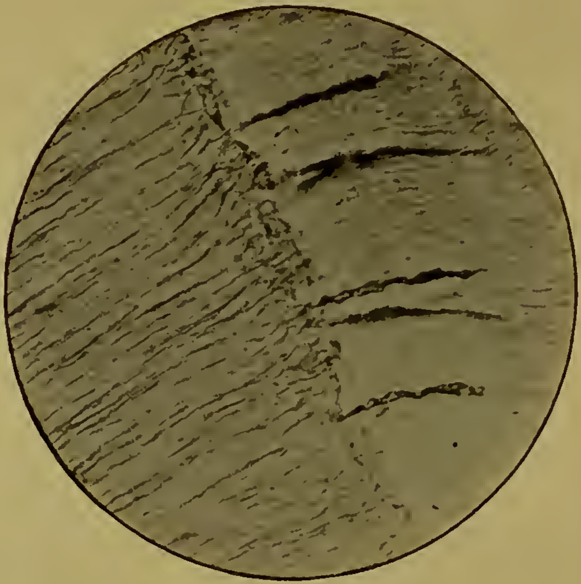
Realizing this fact led to my carrying out a series of experiments with the object of staining any uncalcified tissue, should it exist in the enamel; and it is the result of these experiments, with what they teach, I wish to bring before you. Of the various staining processes tried, the two about to be described are the simplest, while the most efficient, either of them giving very good results.

FIG. 3.



Showing direct communication through the tubuli. (Magnified 200 diameters.)

FIG. 4.



Section showing Römer's corpuscles in the enamel spindles.

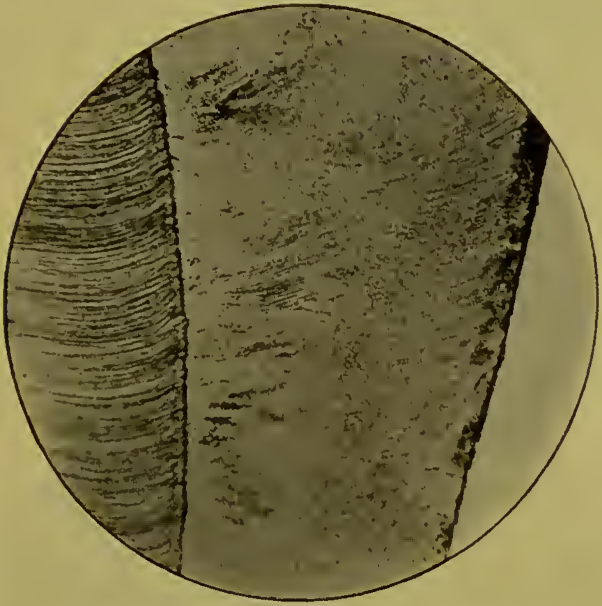
METHODS OF STAINING.

First method. Take any tooth you wish to stain and place it in alcohol from six to ten days, to harden the pulp or to remove any air in the tissue of a dry tooth; then place it in an alcoholic stain of fuchsin for about a fortnight. At the end of that time take the tooth out of the stain and grind it down on a lathe until it is fairly thin; then finish by rubbing the section down between two pieces of ground glass with a little pumice powder moistened with water. When the section is thin enough, dry thoroughly, and mount in balsam.

Second method. Place a tooth in alcohol, as in the previous method, and when the tooth is taken out of the alcohol place it in a hot saturated solution of fuchsin. Then put the tooth and stain in a hot chamber for twenty-four hours; allow the stain to cool, when the tooth will be ready for grinding down. This method gives very good results but makes the enamel more brittle than the slower method. For examination under the microscope it is necessary to use a compensating ocular magnifying 18 diameters, and an apochromatic of 16 mm.

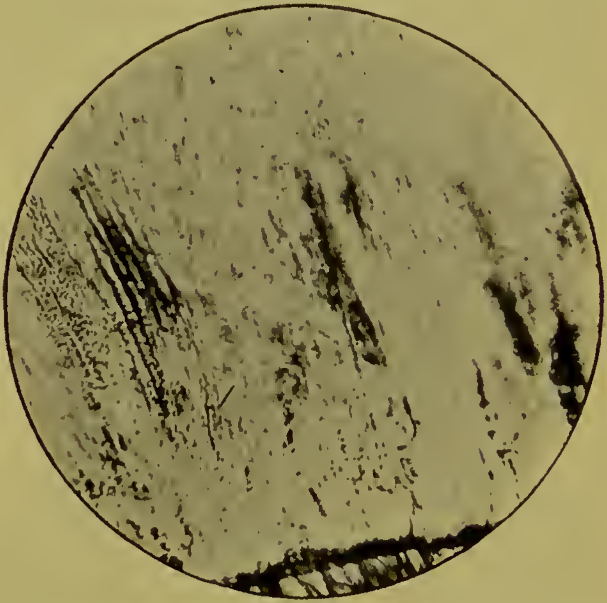
In all cases the staining must be accomplished prior to the cutting of the sections from the teeth, and in no case must acids of any kind be used or there will be the possibility of the alteration of the character of the tissue by decalcification.

Fig. 5.



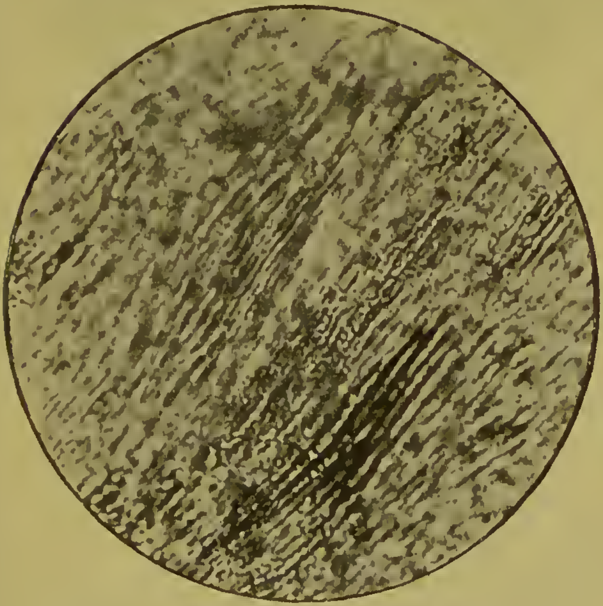
Section of human tooth near the neck, with tubes in the enamel.

Fig. 6.



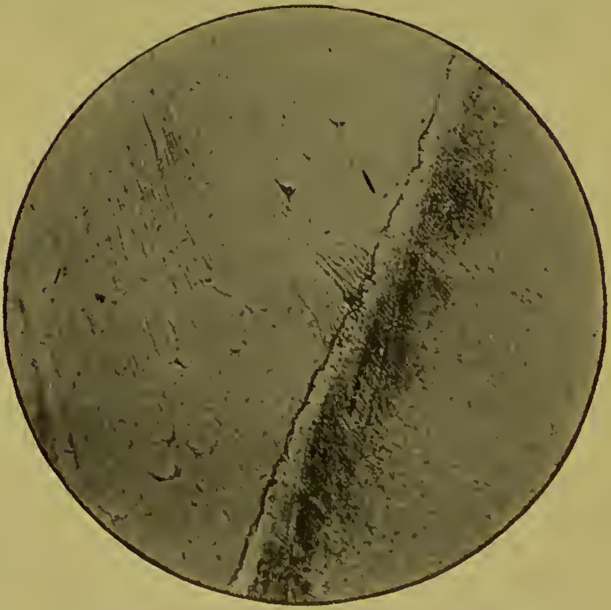
Portion of the previous figure. (Magnified 200 diameters.)

Fig. 7.



Also a portion of Fig. 5. (Magnified 300 diameters.)

Fig. 8.



Section of human incisor, showing short tubes.

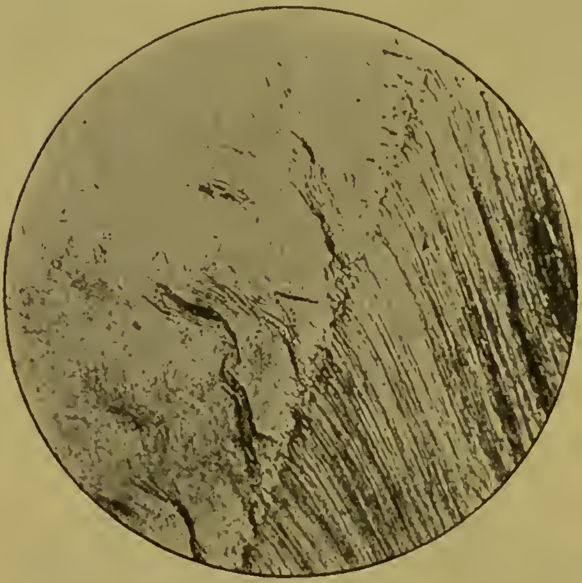
ENAMEL SPINDLES OF VON EBNER.

On examining a section thus prepared, your attention will first be drawn to the pronounced way in which the enamel spindles of Von Ebner are stained. (See Figs. 1 and 2.) We find these spindles are always stained in the same manner as the tubuli of the dentin; and the staining shows that there is a connection between the tubuli of the dentin and these spaces in the enamel. The staining also proves that the contents of these spaces are uncalcified (as the calcified tissue does not take the stain) and probably protoplasmic in character. On examining the next figure we shall see that there is direct communication with the pulp, through the tubuli, into these spaces. (See Fig. 3.)

The constant and regular occurrence of these cavities shows that they are not pathological, as has been suggested by Chas. Tomes, but normal, and probably play an important part in the life of the enamel. These spindles vary much in size, shape, and number; but in every case I think their existence is due to a check in the calcification of the cells forming the enamel, during the development of that tissue. These cavities (the enamel spindles) are certainly not produced by the shriveling up of the cement substance between the prisms, as suggested by Von Ebner, neither are his views correct when he suggests that they contain air, except in those teeth that have been allowed to become dry after extraction, and are cut and mounted in this condition.

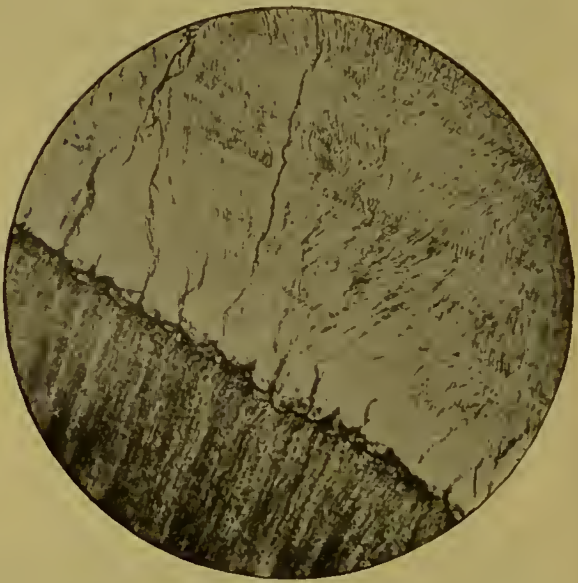
In the soft tissue forming the contents of these spindles, there may at times be seen one or more small glistening bodies; they are hard and unstainable, and are not to be found in every spindle. To these bodies the name of Römer's corpuscles has been given (see Fig. 4) when they exist in the spindles. They are, I believe, composed of minute particles of

FIG. 9.



Section of incisor, showing tubes arranged in bundles. (Magnified 100 diameters.)

FIG. 10.

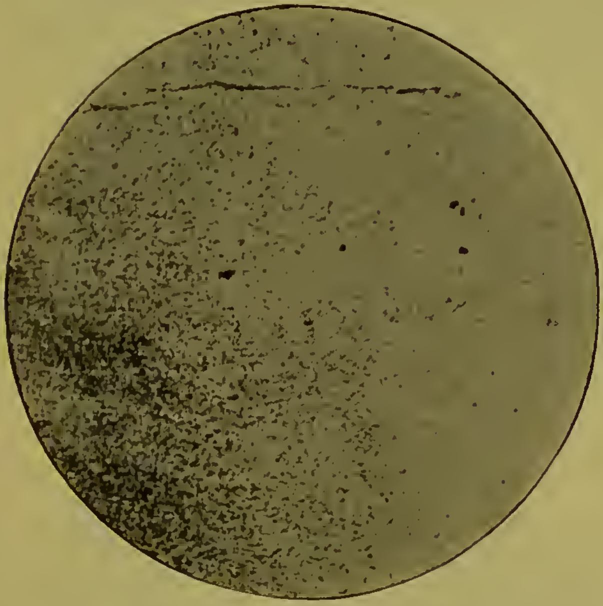


Showing bundles of tubes in tranverse section of human bicuspid. (Magnified 100 diameters.)

calcified enamel, surrounded by the uncalcified tissue of the spindles.

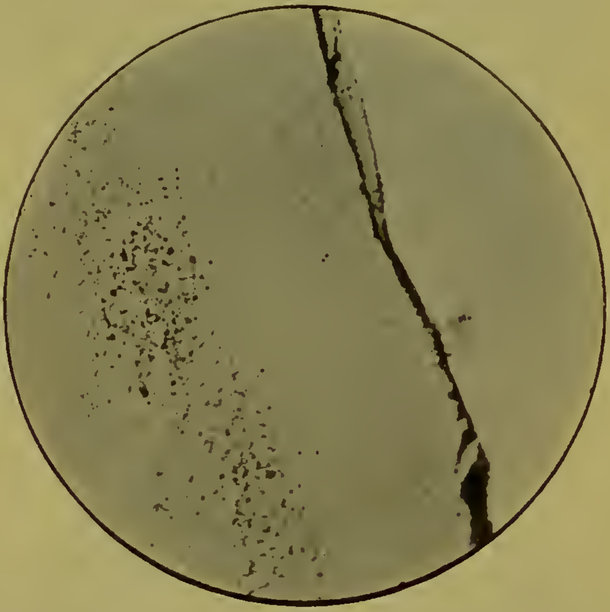
It is very unusual to find any pronounced cavities corresponding to these enamel spindles in the teeth of animals, though in some of the figures from the teeth of animals I have found a modification of the enamel spindles. At the same time, both in the teeth of man and animals, there is to be found a very perfect means of communication between the pulp and the enamel by means of a series of tubes, or tube-like processes, distributed through the latter tissue. (See Fig. 5.)

FIG. 11.



Cut ends of the enamel tubes. (Magnified 100 diameters.)

FIG. 12.

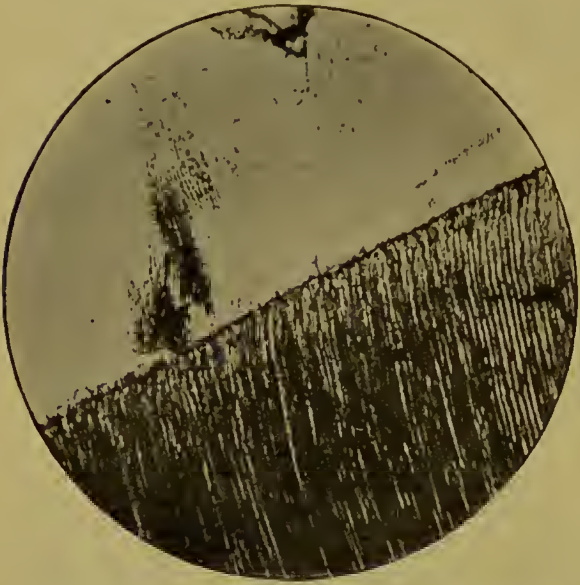


Cut ends of the enamel tubes. (Magnified 150 diameters.)

As these tubes exist in some form in all the teeth I have examined, we may surely consider them as normal, and not pathological; and finding no record of their existence in this tissue, I shall for the purpose of describing them call these spaces enamel tubes. Their position in the enamel tissue is between the prisms. They have no sheath such as is found in the tubuli of the dentin, the calcified enamel prisms forming their walls, or sheaths. The contents of these tubes are composed of uncalcified tissue, and are probably produced by non-calcification of the tissue (cement substance or otherwise) that exists between the calcified enamel prisms. (See Figs. 6 and 7.)

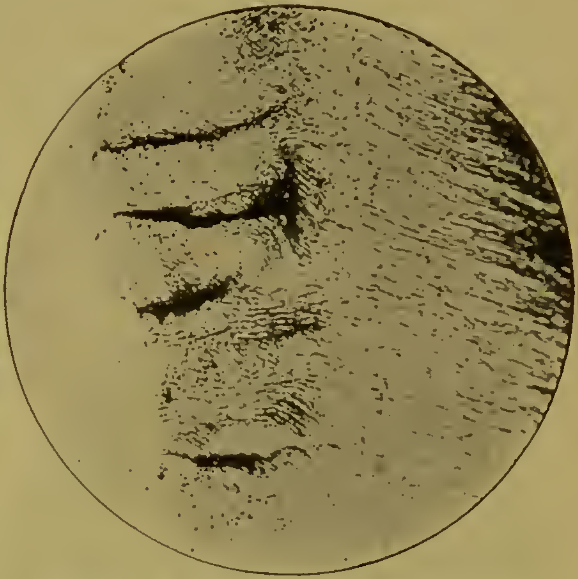
These tubes vary much in size and length, according to their position in the tooth; thus, near the neck they appear as short, separate tubes. (See Fig. 8.) But as we approach the apex of the tooth these tubes are frequently found grouped together in bundles. (See Fig. 9.) These tubes also take this form in the crowns of the bicuspids and molars. (See Fig. 10.) The bundles of these tubes frequently assume the form of a spiral, with the upper portion branching into two or more divisions, or they may radiate from their base and spread out like a fan. In either case it is almost impossible to get the whole of the bundle into focus under the microscope at the same time.

FIG. 13.



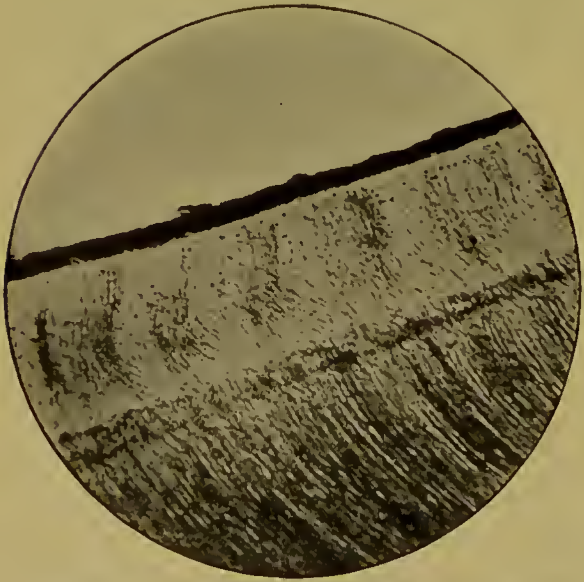
Section of incisor of gorilla, showing bundles of enamel tubes.

FIG. 14.



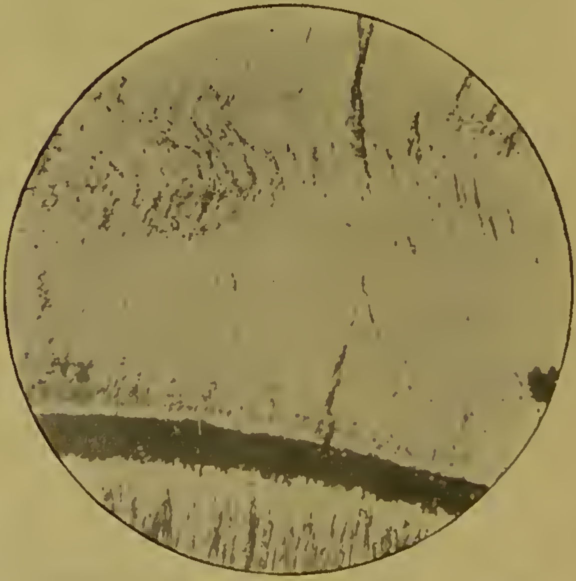
Section of canine of fox, showing straight tubes and tubes crossing each other.

FIG. 15.



Section of tooth of dog, showing tubes in the enamel.

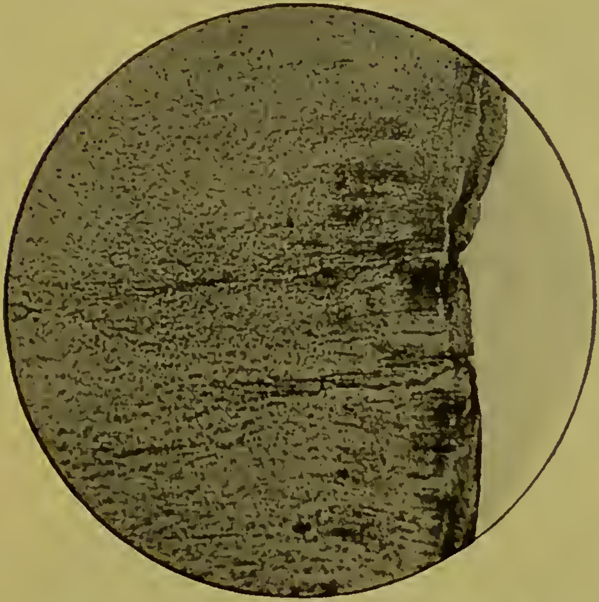
FIG. 16.



Section of upper incisor of cow, with tubes in the enamel.

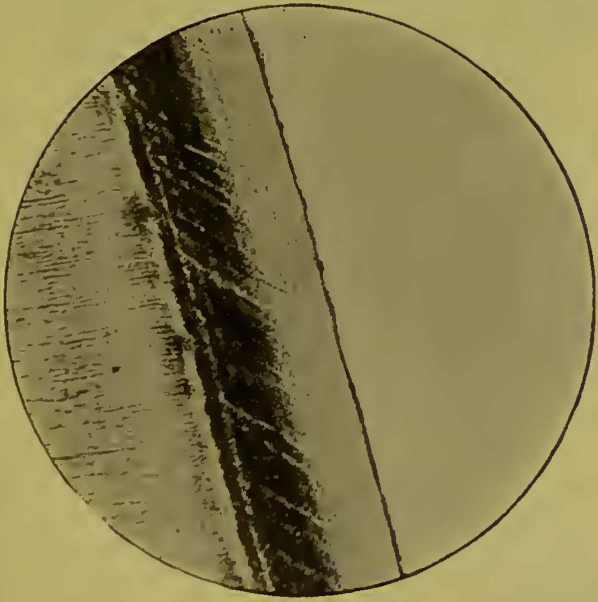
To prove the connection between the pulp and these tubes is an easy matter, owing to the ready manner in which they take the stain. (In the figures the dark portion in the enamel corresponds to the stained portion of the microscopic slide.) That these tubes are distinct spaces in the enamel, and consist of uncalcified tissue, is proved by the staining, and from the fact that wherever there are cut ends of these tubes the ends are always stained in the same manner as the cut ends of the tubuli of the dentin. (See Figs. 11 and 12.)

FIG. 17.



Section of tooth of pig, showing tubes in the outer portion of the enamel.

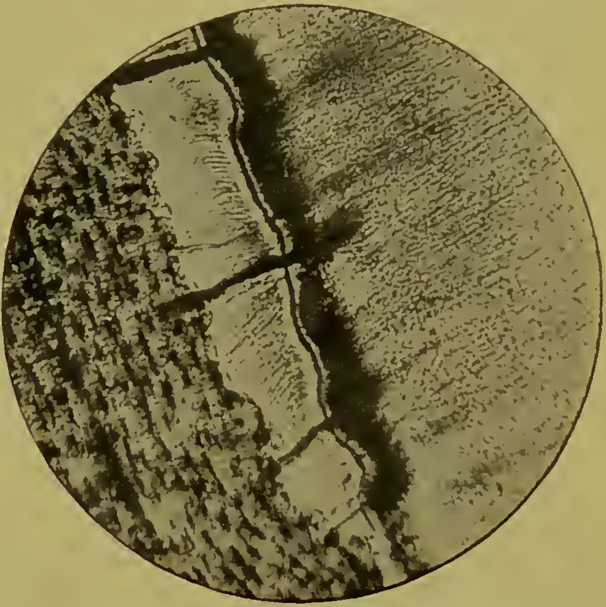
FIG. 19.



Section of incisor, showing enamel tubes in the tooth of rat.

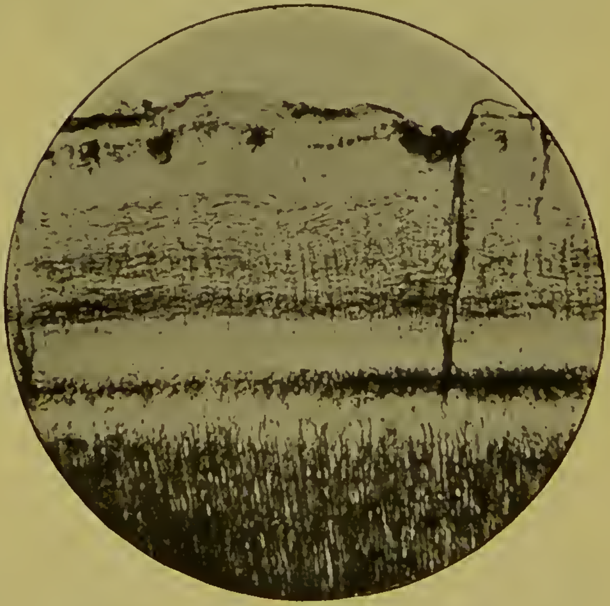
The tubes in some form are contained in the teeth of the following animals: In the *primates* we have examined the teeth of man and the gorilla (see Fig. 13). In the *carnivora* we find them in the fox (see Fig. 14); in the dog (see Fig. 15). In the *ungulata* we find them in the cow (see Fig. 16), in the pig (see Fig. 17), and in the horse (see Fig. 18). In the *rodents* we have these tubes in the teeth of the rat (see Fig. 19);

FIG. 18.



Transverse section of incisor of horse, with enamel showing tubes. The enamel is between the dentin and the cementum.

FIG. 20.



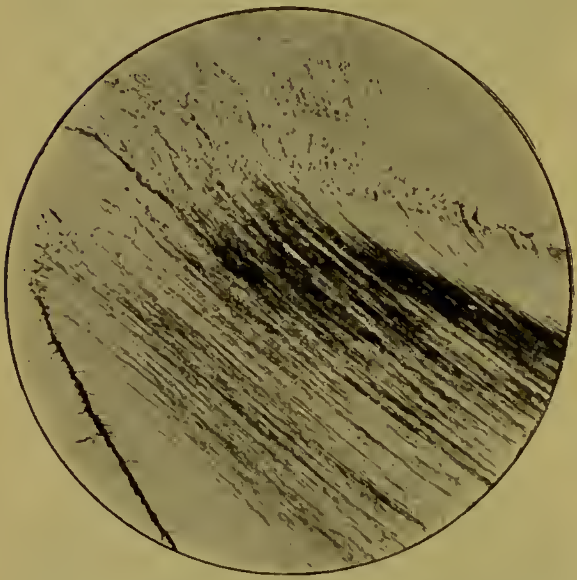
Section of tooth of alligator, with tubes in two directions.

whilst from the tooth of the alligator we have a most interesting illustration, for in this case the tubes not only pass from the dentin toward the outer surface of the enamel, but are to be found in bands surrounding the dentin. (See Fig. 20.)

That we may better understand the way in which the stain passes into the tubes in the enamel from the pulp, I will for a short time draw your attention to the point of connection between the two tissues, the enamel and the dentin. In most cases immediately under the enamel the tubuli of the dentin branch very much, frequently anastomosing, and forming a complete network of small tubes along the edge of the dentin at the enamel margin. (See Fig. 21.) This network of the tubuli is an early stage of a granular layer, as found in the teeth of some animals we have examined. If we now take a section from the tooth of the pig, we find that the branching is more pronounced, and that a rudimentary granular layer is to be seen under the enamel. To advance a stage further, I shall draw your attention to the teeth of the fox; in these teeth we have a granular layer well developed under the enamel. (See Fig. 22.)

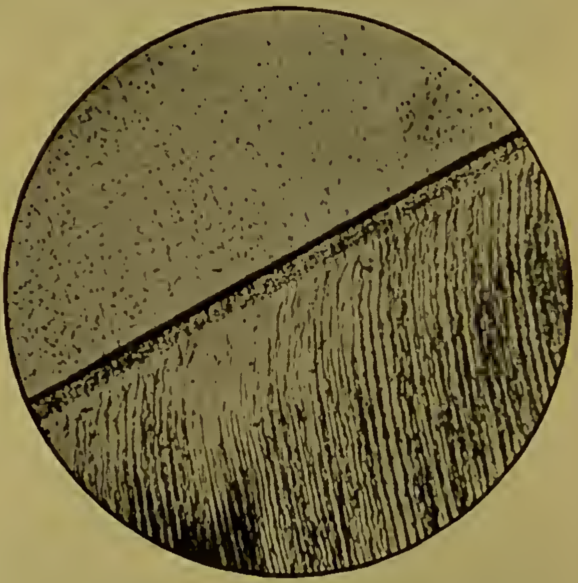
In passing to the next, and last, figure illustrating the development of the granular layer under the enamel, I shall draw your attention to a section of a tooth of a cow, as in this animal we have a perfect granular layer in the teeth corresponding to the granular layer between the dentin and the cementum, and continuous with it. (See Fig. 23.) The tubuli of the dentin terminate in this layer on the one side, and the enamel tubes usually pass into it from the other side, thus making the ends of the tubuli, and the

FIG. 21.



Section of human incisor, showing connection between the tubuli of the dentin and the tubes in the enamel.

FIG. 22.

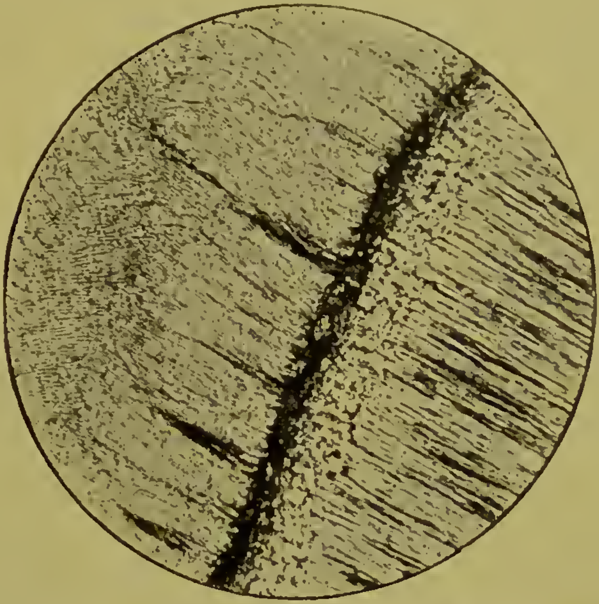


Section of tooth of fox, showing branching of the tubuli, granular layer under the enamel, a layer of deeply-stained uncalcified tissue between the enamel and the dentin, and cut ends of tubes in the enamel.

granular layer where it exists, the means of communication between the two tissues.

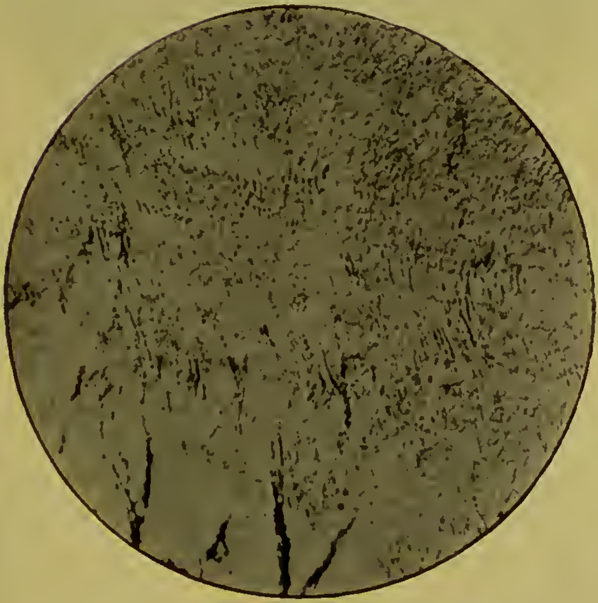
ing the stain readily. (See Figs. 24 and 25.) This network of uncalcified tissue continues through the enamel until we reach the outer portion of this tissue, when we find a series of larger tubes passing from the outside toward the central portion of the enamel tissue.

Fig. 23.



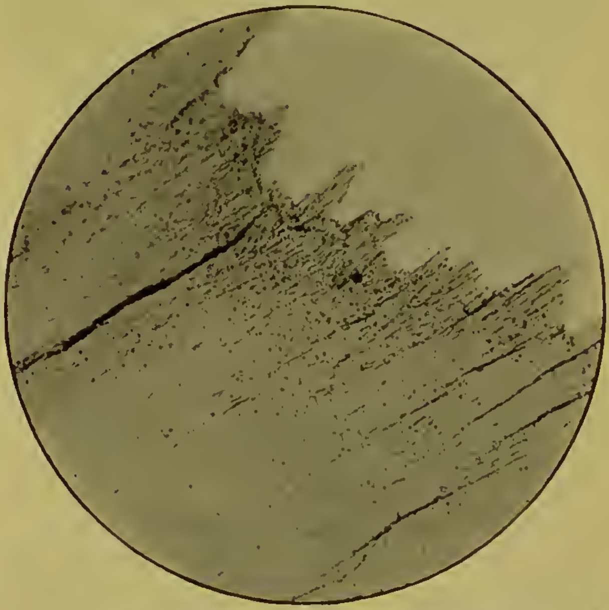
Section of tooth of a cow, showing granular layer and enamel tubes.

Fig. 24.



Section of a molar, with a portion of the enamel broken away after the section was ground down to show the line of fracture and the stained tissue between the prisms.

Fig. 25.



A similar section to that illustrated in Fig. 24, but unbroken, showing the stained tissue between the prisms.

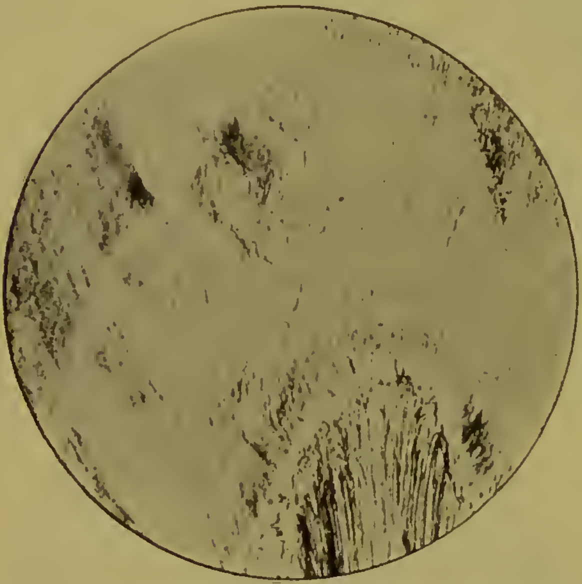
There is also to be found in the enamel, besides the spindles and tubes, a more or less complete network of uncalcified tissue passing between the prisms, and tak-

Before referring to these tubes in the outer portion of the enamel, I should like to draw your attention to this method of staining for the purpose of following the curvature of the enamel prisms, by presenting a section of an upper bicuspid, showing the curvature of the prisms and the way in which they cross each other. (Fig. 26.) In the incisors and canines this curvature of the prisms is not very pronounced, except at or near the cutting edge of the teeth; but in the bicuspids and molars the reverse is the case, for in these teeth the curvature is most pronounced; and I believe there is a very useful purpose for this curvature. We all know the ease with which the enamel can be cut along the line of fracture at or near the neck of the tooth, where the prisms are straight; but try to do the same on the crown of a bicuspid or molar and you will find that the resistance is very great. The cause of the resistance is the curvature of the prisms, and the reason of this curvature is that the teeth may overcome the strain put upon them during the process of mastication.

We will now return to the enamel tubes that appear on the outer portion of the tissue and pass inward. (See Fig. 27.) This figure shows that these tubes are larger than those in the center of the enamel, and that they are regular in arrangement and frequently grouped together. In some animals, especially in the cow, amongst these tubes are frequently to be found bundles of tubes similar to the bundles found on the margin of the enamel near the dentin. (See Fig. 28.)

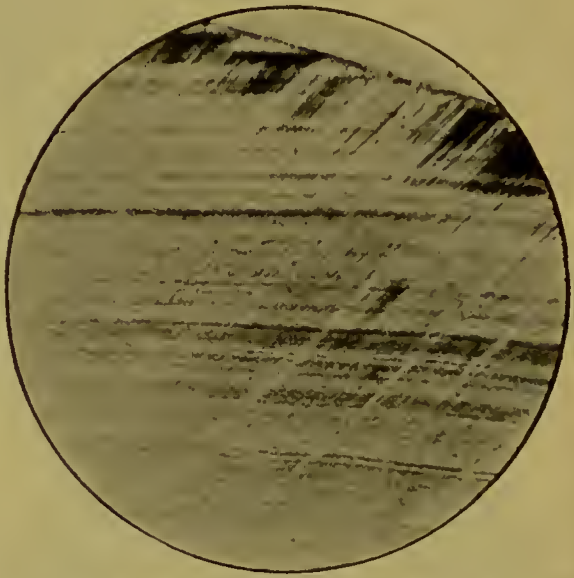
I said in the earlier portion of my paper that these spindles and enamel tubes play a very important part in the life of the enamel. The following are, I believe, some of the functions of the uncalcified tissue of the enamel: (1) To convey sensation from the outside of

FIG. 26.



Section of upper bicuspid, showing the curvature of the prisms and the way in which they cross each other.

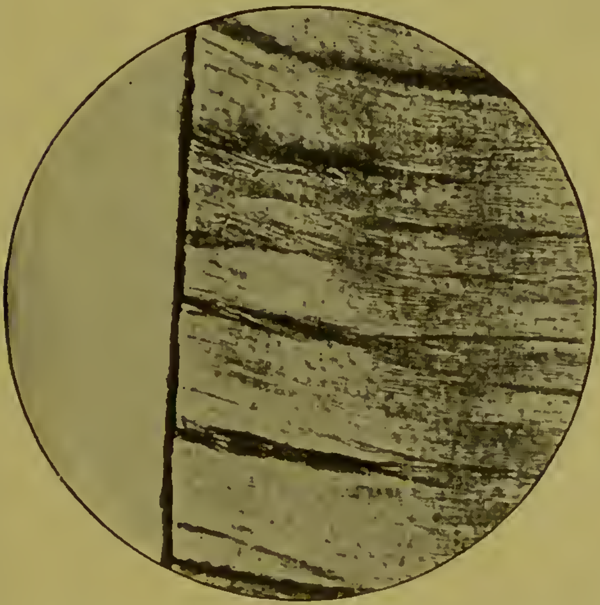
FIG. 27.



Section of human tooth, showing the outer edge of the enamel, with tubes passing toward the center of the tissue.

the enamel to the pulp, especially in cases of erosion and sensitive enamel. (2) To allow for any expansion or contraction that may take place in the enamel. (3) As a means of conveying nourishment to the enamel during the life of the pulp. I am convinced the enamel is a live tissue as long as the pulp is alive, and, as a consequence, there is no change in the color of the enamel until the enamel dies with the death of the pulp.

FIG. 28.



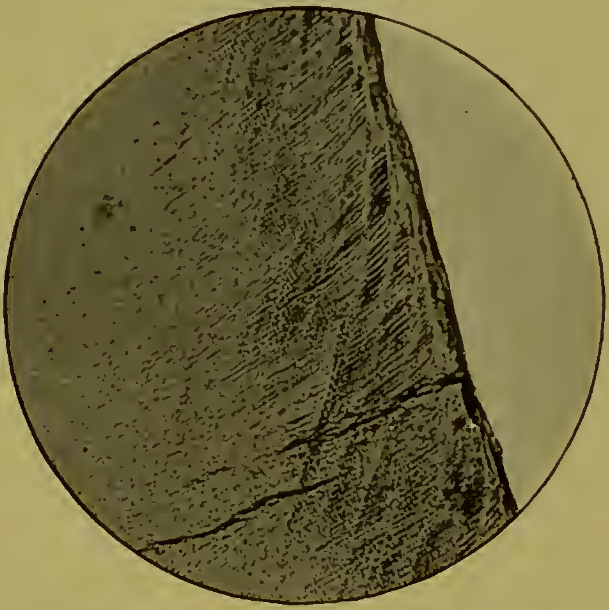
Section from the incisor of the cow, showing bundles of enamel tubes. (Owing to the curved form of these bundles it is impossible to get the whole in focus at the same time.)

There are still two portions of this tissue to which I desire to draw your attention: (1) The brown striæ of Retzius; and (2) Schreger's lines.

THE BROWN STRIÆ.

There has been much discussion as to the cause of these markings. A. Hopewell-Smith says that "These stratifications are only visible in vertical sections." In this he is not correct, as I shall give illustrations both longitudinal and transverse, in which they appear. He also says, "The striæ of Retzius are due to pigmentary deposit in the prisms. The theories propounded by Von Ebner and Kölliker have been dismissed by Leon Williams as incorrect. The former observer supposes that the bands are due to imprisoned air or gas which has entered the ground-off ends of the rods through minute channels, and to this Leon Williams replies that the idea is a mistaken one: first, because the supposed canals have no existence; secondly, because the ground-off ends of the enamel prisms do not appear except when the sections of enamel are ground off at a certain angle."

FIG. 29.

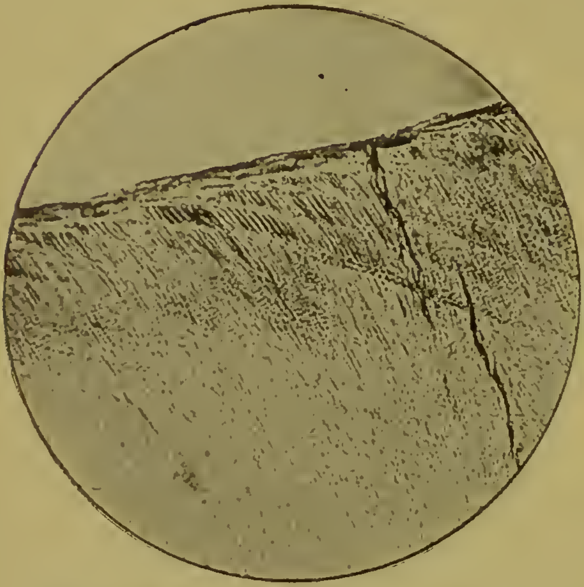


Longitudinal section of human tooth, showing brown striæ.

We will now see how the theories of Leon Williams agree with what the illustrations show us. First, we will examine the theory of pigmentation producing the brown striæ. (See Fig. 29.) The first thing you will notice is the absence of anything approaching to pigmentation in the prisms; each prism in this portion of the enamel is free from pigmentation, as are the prisms in any other portion of this tissue. Secondly, between each prism there is a stained portion in the form of a short canal, about the same width as the prism. Thirdly, passing inward toward the center of the enamel is a series of the cut ends of these canals, in the form of a number of dots. I think this figure will convince anyone that the views of Leon Williams are not in accord with what is shown by this method of staining. If we now examine a transverse section of a tooth (see Fig. 30), we find the same structure, minus the cut ends of the prisms; and in the next illustration (see Fig. 31), showing a longitudinal section, the enamel is thinner than in Fig. 29, and as a consequence shows the structure better. We have here the same structures as in the previous illustrations.

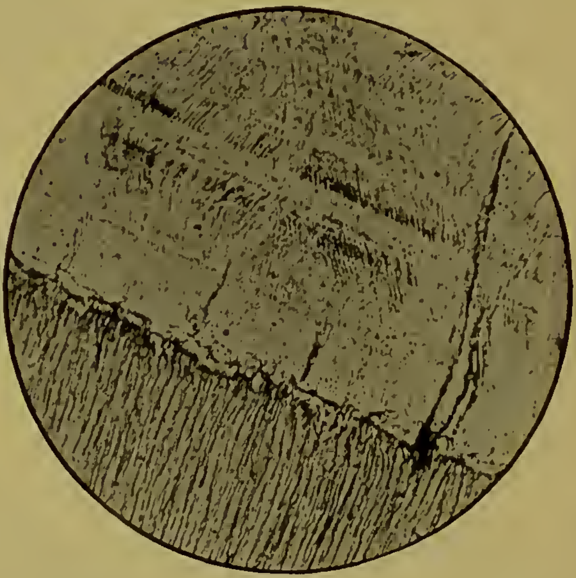
Having shown that there is no pigmentation in the prisms, and that there is what Von Ebner may well call canals, also that it is possible to see both the canals and the cut ends of some of them in the same illustration, we find there is nothing to confirm Leon Williams' theory of pigmentation, whilst Von Ebner having probably made his examination upon dry teeth, we can easily understand how he made the slight mistake, if we may call it such.

FIG. 30.



Transverse section of enamel through brown striæ.

FIG. 31.



Showing longitudinal section of enamel through brown striæ.

After having examined a large number of these sections I am convinced that the brown striæ are produced by the difference in the refractive index of the prisms and the large number of enamel tubes that exist in this brown striæ. These tubes take the stain well. They are usually larger, more regular, and more pronounced than in any other portion of the enamel, except when these tubes form bundles on the margin of the dentin.

In some sections the prisms between the tubes appear slightly pigmented. This is due to the thickness of the section, and is produced as follows: When a section consists of more than one layer of enamel prisms the tubes in each individual layer are not directly under each other, and, as a consequence, the light has to pass through the canals before it reaches the prisms. In this case the result of the difference of the refractive index of the different portions of the tissue is to produce the appearance of pigmentation in the prisms. To prove this, grind the section thinner, and the appearance of pigmentation disappears.

These brown striæ are not confined to human teeth but are to be found in the teeth of many of the animals examined.

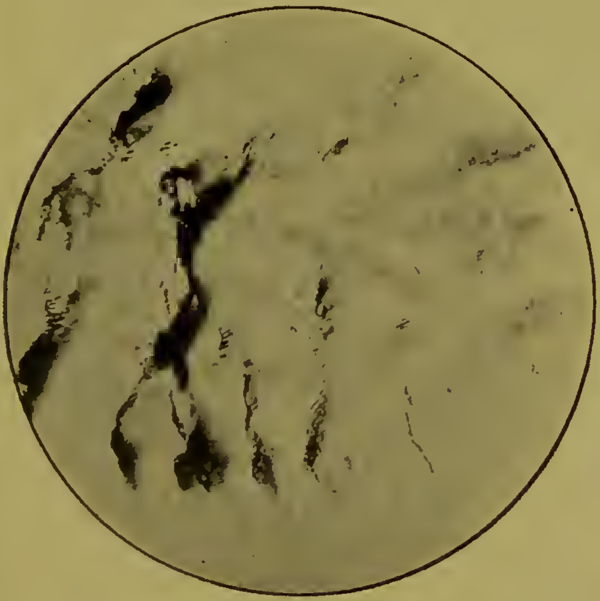
THE LINES OF SCHREGER.

Though the cause of these markings is the same as that which produces the brown striæ (the increase in the tubes between the prisms, and the difference of the refractive index), the effect produced is very different in appearance. In the lines of Schreger we have a beautiful cloud-like effect, produced by the curvature of both the prisms and the canals. On carefully examining the illustration you will see the tubes are quite distinct where they are in focus, and by altering the focus when examining the slide under the microscope the curvature can be easily followed. (See Fig. 32.)

Doubts have been raised by some as to the correctness of the theories expressed in this paper, as they do not agree with the analysis of enamel as recorded by Chas. Tomes, who states that there is no uncalcified tissue in the enamel; but, as I have already stated, of all the analyses published no two agree, hence the difficulty of accepting any one as reliable.

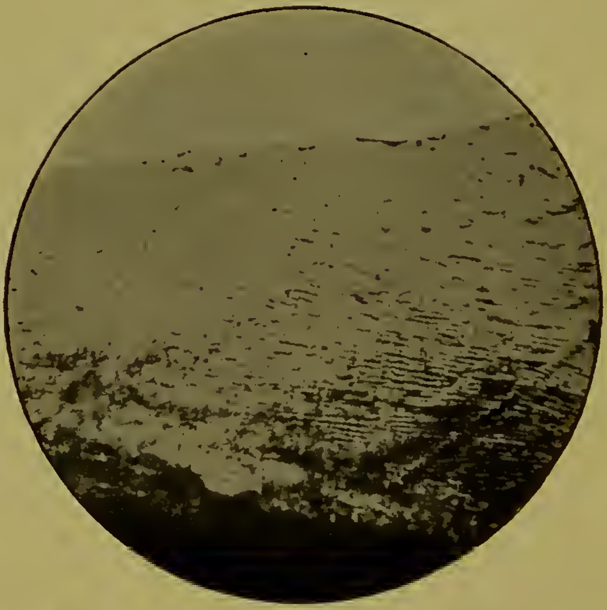
In this difficulty I consulted my friend E. H. Farr, F.C.S., and he suggested the following chemico-microscopical test, which he has kindly carried out for me: Take a section of enamel that has been ground very thin; carefully remove all the dentin from the section, and then

FIG. 32.



Showing Schreger's lines. (Magnified 100 diameters.)

FIG. 33.



Section of carbonized enamel, showing uncalcified tissue.

place the section in fused borax and thoroughly heat the enamel, so that if there be any uncalcified tissue it may become carbonized. Now carefully dissolve out the borax, and if there be any uncalcified tissue it should show dark brown or black when the section is mounted for microscopical examination. The last illustration (Fig. 33), showing a section of carbonized enamel, illustrates well the uncalcified tissue, corresponding to the stained tissue of the enamel.

Dr. CRYER in his closing remarks thanked all those who had taken an interest in the work of the section, especially those who had contributed papers. In this connection he particularly wished to thank Dr. Wm. S. Haughton, of Dublin, Ireland, for so kindly sending to the section stereoscopic radiograms, which had been greatly appreciated and admired by all who had examined them.

Section I then adjourned *sine die.*

Fourth International Dental Congreſs.

SECTION II.

SECTION II:

Etiology, Pathology, and Bacteriology.

Chairman—Dr. R. H. Hofheinz, Rochester, N. Y.
Secretary—Dr. M. L. Rhein, New York, N. Y.

FIRST DAY—Monday, August 29th.

The section was called to order on Monday, August 29, 1904, at 2.30 P.M., by the chairman, Dr. R. H. Hofheinz.

The Chairman. Before proceeding with the work of the section, I have to announce that the name of Dr. M. L. Rhein of New York has by some inadvertence been omitted from the program. He has kindly consented to serve as the secretary of this section.

While I read my short address I will ask Dr. W. D. Miller of Berlin, Germany, to occupy the chair.

Dr. Miller then took the chair.

Dr. R. H. Hofheinz, Rochester, N. Y., then read the following address:

Chairman's Address.

Gentlemen of Section II: It is with much pride and gratification that I welcome you as members of the Section on Etiology, Pathology, and Bacteriology, of the Fourth International Dental Congress. They are the three great sciences which have brought dentistry to its present elevation.

There was in modern nations, at least, a time when dentistry mainly consisted in the art of extracting diseased teeth and of soothing dental pains by means of drugs. From that, dentistry rose to a highly developed technical branch, but it has now reached a status where the happy combination of the practical and theoretical have made dentistry a recognized science.

As one of our distinguished members well said, "Any science based on experience *in* and tending *to* life must be practical as well as theoretical." This, gentlemen, ought to be a self-evident truth to every attentive observer of the evolution and application of science in all its multifarious branches, and most of all, perhaps, in dentistry, which from a much neglected branch of surgery rose to the rank of an independent science by means of theories and practical experiments combined.

It is the theorist who by careful examination of cause and effect, assisted by practical experiments, has heaped observation upon observation, experience on experience, conclusion on conclusion—gathering a treasure of knowledge which well deserves the honorable name of science. In dentistry, as in any other empiric aggregation of facts, the sum of experiences gained leads to theories, the verification of such to scientific principles; and modern dentistry is therefore built up by both theory and practice combined.

Strange it is that even today there should be men who, as Dr. Kirk remarked, look upon such theories and such observations as "scientific things for which the practical man has no use." This is the same antagonism as was experienced by the scientific physician of the middle ages, when anatomy was tabooed and surgical operations were left to vagrant quacks, considered as outlaws at a time when the University of Paris refused admission to students of the medical faculty who were not willing to swear off the pursuit of surgery.

The practical physician of that time had no use for scientific researches, and he despised any theory based upon it and upon the discoveries made by anatomy. And yet it is an undisputed fact that medicine obtained the rank of a real science only after adopting those branches into the regular course of instruction for medical students, and we know now from the history of its evolution that the astonishing development of medical science would have been impossible to this day without them.

The crude empiricism of the quack was through them replaced by scientific methods based on the perception of cause and effect and logical conclusions. The physician advanced from the low station of the practitioner of thoughtless mechanical routine in rules and prescriptions mostly founded on the *post hoc, ergo propter hoc* principle to a self-thinking scientist basing his conclusions on his observations and who tries to apply his remedies with full knowledge of the cause of the disease and the effect of the agents he applies and prescribes. Every practitioner of the medical and dental sciences forms his theories by his observations, and they approach the real truth in the ratio of their accuracy and scientific exactness. Only lamentable bigotry can deny these facts.

If we had not learned to investigate the phenomena of caries by scientific method and correct reasoning, dentistry would still rest on false and perfunctory observations, or it would perhaps have advanced a little more by slow and hazardous empiricism, with scanty results gained by a great number of lamentable failures.

Goethe says, "Much confusion in science, and in everything else, arises from this, that men who have no capacity for thought will presume to theorize, because they cannot see that mere stores of knowledge, however vast, in themselves give no capacity for thinking. Such persons at starting will go on working with a fair amount of common sense and succeed pretty well; but common sense has its limit, and when it passes beyond that limit it is in danger of becoming absurd. The province of common sense is active life—in action it will not lightly go wrong; but the higher regions of thought, speculation, and broad conclusions are altogether outside of its jurisdiction."

Dentistry has produced many minds who have entered the higher regions of thought and have derived therefrom definite and important conclusions; a number of them will honor this section with some of their mental product. These men and their work have helped dentistry to its present lofty position, and have compelled the medical profession to accept their thoughts and researches as belonging to the great realm of medical science. Thus through its scholars in etiology, pathology, and bacteriology has dentistry won one of the foremost places among the sciences of the twentieth century.

Dr. Hofheinz here resumed the chair.

The CHAIRMAN. The fiıst paper which will be read before this section will be on "Constitutional Causes of Tooth-Decay," etc., by Dr. Eugene S. Talbot of Chicago.

Dr. E. S. TALBOT, Chicago, Ill., then read his paper entitled "The Constitutional Causes of Tooth-Decay, Erosion, Abrasion, and Discoloration," as follows:

Constitutional Causes of Tooth-Decay, Erosion, Abrasion, and Discoloration.

By **EUGENE S. TALBOT, M.S., D.D.S., M.D., LL.D., Chicago, Ill.**

[AWARDED "HONORABLE MENTION" BY COMMITTEE ON PRIZE ESSAYS.]

To Dr. W. D. Miller is due the honor and credit *par excellence* for his masterly discovery of the local causes of tooth-decay. Unlike etiologic discoveries in other diseases, that of lactic acid ferment but partially suggests prophylaxis. Indeed, despite treatment, tooth-decay is more rapid and widespread today than formerly; with each generation ushered into the world the ravages of decay increase. This being the case, what are the underlying factors influencing these conditions?

The underlying factors which are set forth at length in my paper entitled "Anatomic Changes in the Head, Face, Jaws, and Teeth in the Evolution of Man," in the Section on Anatomy, Physiology, Histology, and Microscopy*—comprise the phases of the evolution of the face, jaws, and teeth. These are modified by neurasthenia and faulty nutrition of one or both parents or the child, or of all combined. If this be doubted, let the skeptic compare his patients with children of similar ages in any school for degenerates in this or any other country, or compare healthy normal children with the degenerates of the same family. Naturally, the secretions of the mouth are vitiated by the conditions named, and the lactic acid ferment is assisted. Vitiated excretions, however, do not account for all facts in the following cases.

A woman, twenty-two years old, a lifelong patient, became pregnant. Her teeth, which had been in fine condition up to this period, decayed rapidly thereafter. Caries appeared around new fillings and many new cavities occurred within twelve months.

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* [Transferred from Section I to be read in general session: see page 61.]

A girl of fourteen years had her teeth put in order in September 1903. She went to a preparatory boarding-school. She returned in June 1904 with thirteen cavities, some around fillings but mostly new ones.

A man forty-six years of age, a broker, had sound healthy teeth with few fillings until an attack of nervous prostration consequent on business strain occurred, when his teeth decayed rapidly, softening so that the detritus could be removed like leather.

A minister of thirty-eight years with a fine set of teeth broke down in health from overwork. After three years' absence in France he returned to America with every tooth decayed, twenty-one of his teeth having to be crowned.

A woman of forty-six years had two sons and a daughter. The daughter at eighteen was attacked with peritonitis and died within a week, thereby plunging her mother into deep depression. The mother's teeth, previously in good condition, presented in eight months many cavities.

A woman of forty-two years, well-to-do financially; her husband had charge of her property. She went abroad for two years, and he was to bring her home at the end of that period. He failed to do so, and kept her abroad for two years more. Remittances became short, and she returned to find that her husband had squandered her property, and she obtained a divorce. Resultant worry, according to the dermatologists consulted, turned her hair white. There was marked recession of the alveolar process and gums from interstitial gingivitis, as well as rapid tooth-decay.

The husband of a woman of thirty-five years suddenly died, plunging her into deep depression. Her teeth softened rapidly and decayed.

In all these cases abrasion or erosion or both, and in some cases discoloration of tooth-substance, occurred. That teeth decay during illness all observers admit.

A surgeon of sixty-four years with arterio-sclerosis has an unusually well-marked abrasion and erosion with interstitial gingivitis and loosening of the teeth.

A mechanical engineer of forty-eight years has rapid erosion, discoloration, interstitial gingivitis, and loose molars.

Smale and Colyer* have observed erosion and abrasion with gout.

Tomes† mentions the case of an anemic girl reduced to prostration by acute dyspepsia and confined to her bed for some time. She was so hysterical that it was difficult to correctly diagnose her condition. At one time, there was great tenderness of the teeth and general periostitis in the front of the mouth, which to judge by the color seemed to have resulted in the death of the upper central incisors. The use of alkaline applications had no effect, but the patient's general condition improved and the disease made very little progress.

Marshall‡ relates the case of a man of forty-five years in which the six anterior teeth and the right first bicuspid of the upper jaw were greatly affected, the enamel being completely removed from the anterior surfaces of all the teeth mentioned, with a considerable portion of the dentin, leaving an inclined plane pointing backward and extending from the margin of the gums to the ends of the teeth, shortening the anterior teeth to the extent of about the sixteenth of an inch.

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* "Diseases and Injuries of the Teeth," p. 280.

† Marshall's "Operative Dentistry," p. 363.

‡ *Trans. Amer. Med. Association*, 1884.

The denuded surfaces were not all grooved in one direction; the central incisors and the left lateral were grooved horizontally like the others, but were also grooved longitudinally at the cutting edges.

Many cases of erosion, according to Darby,* are associated with the gouty diathesis. This constitutional condition is, in his opinion, an important factor in causation.

Miller† mentions the case of a man of forty-five years who was in fair health with the exception of an occasional attack of asthma and a rheumatic tendency, and who was the subject of a well-marked case of erosion.

My attention was called to erosion and abrasion three decades ago, while making investigations among neurotics and degenerates for other purposes. Degenerate children were found to have erosion and abrasion of the temporary as well as the permanent set of teeth. In paretic dementia—a disease which usually runs a rapid course and terminates in death—abrasion is almost always marked; sometimes erosion occurs. In locomotor ataxia erosion and abrasion are always present, frequently to a marked degree. In practice I find erosion and abrasion of the temporary teeth—especially of the incisors and canines that have remained in the mouth for a longer time than normal—after the roots have become absorbed and the pulps have been destroyed. Patients with hard, sound normal teeth up to a certain period, may afterward, from neurasthenia, degeneracy, or grief, show marked traces of erosion, abrasion, and decay. The same is true of syphilis, tuberculosis, or any other constitutional disease.

Erosion and abrasion are often seen in the permanent teeth after the pulps have been destroyed.

Erosion, according to Miller, "is an effect observed in healthy teeth with living pulps, as well as on pulpless teeth, and on natural teeth worn as pivot teeth or on artificial bases."

Erosion and abrasion are observed upon the cutting edges of the anterior teeth, especially the central incisors where there is no friction from opposing teeth. Occasionally the central incisors, either upper or lower or both, alone are involved.

Erosion and abrasion are found in mouths with healthy gums and mucous membrane and upon teeth in localities where acid secretions could have no effect. The character and shape of the abraded surfaces indicate that the origin is from friction.

Change in color of the teeth is often very rapid after prolonged illness, such as pneumonia, typhoid fever, syphilis, tuberculosis, etc. I have noticed many cases of change in color after illness in persons who have had partial sets of teeth or when a crown had been inserted. All are familiar with the rapid change in color as patients advance in years. Teeth often change color during pregnancy.

I purposely grouped "Constitutional Causes of Tooth-Decay, Erosion, Abrasion, and Discoloration" under one heading for the reason that I expect to show that the changes which take place in the pulp from constitutional disturbances modify tooth-vitality. The local causes are thereby accelerated. In all the cases enumerated, either the nervous system or blood supply or both are involved. While all of these lesions are observed early in life, they are most active after forty years of age. It is especially at the senile stage—the fifth period of stress, or period of involution, when the excretory organs, from overwork or nerve tire, cause faulty metabolism and auto-intoxication—that the teeth undergo changes indicated by rapid decay, discoloration, erosion, and abrasion.

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* Marshall's "Operative Dentistry," p. 366.

† *Dental Cosmos*, March 1904, vol. xlvi, p. 177.

Changes taking place in tooth-structure must necessarily occur either in the blood stream or nerve tissue. Investigations of nerve lesions have demonstrated that in most diseases, nerve-end degeneration takes place, as Sidney Kuh* has shown. In some of the toxic forms, as for instance in neuritis due to poisoning with lead and arsenic, the cells of the spinal cord as well as those of the spinal ganglia and brain may be diseased and the toxic substances may attack these cells before the nerve fiber itself is altered. This hypothesis explains why pronounced degeneration of peripheral nerves occurs without causing any appreciable symptoms. Pitres and Vaillard first showed that after typhoid fever many nerve fibers are found degenerated in cases where during life symptoms of neuritis were absent. The same observer found like states in the nerves of those who had died from tuberculosis. Later observations have extended these conditions to such diseases as diphtheria, syphilis, alcoholism, carcinoma, inanition, marasmus, arterio-selcrosis, and leprosy; in the so-called rheumatic neuritis of the facial nerve, and in inflammation due to articular rheumatism, gout, puerperal infection, tuberculosis, etc.

The method of cell-poisoning has been observed in other intoxications.* Certain groups of neurons are more susceptible than others to a given intoxication. The same group of nerve cells in two individuals may react very differently to similar doses of the poison. The syphilitic toxin shows a decided preference for certain parts of the cerebral cortex, other areas being less affected. The nerve endings in all parts of the body are markedly involved, especially those in and about the teeth. Peripheral nerve degeneration results where the blood current or the nerves themselves are involved from faulty metabolism, neurasthenia, etc.

If disease affects nerve endings elsewhere in the body, it is but reasonable to believe that nerve endings, bloodvessels, and connective tissue in the pulp will likewise be involved, since the pulp is an end organ situated within bony walls, and a transitory structure is doubly susceptible to disease. The tooth-pulp is at its highest physical development when it commences to form dentin. From that time it degenerates; it begins to lose its blood supply and its nerve energy. As age advances, the blood and nerve supply is almost at a minimum. Is it surprising that so few pulps are found in normal condition?

For the past eight years Dr. Vida A. Latham and myself have made a special study of dental pulp pathology. The results of our efforts have been presented before the Section on Stomatology of the American Medical Association and published in both medical and dental journals. Teeth in all stages were obtained from patients suffering from many diseases. These teeth upon removal were placed in warm water, salt solution, and

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* *American Medicine*, vol. iii, No. 21, pp. 865, 868.

* Barker, "The Nervous System," p. 243.

Müller's fluid. The pulps were removed and placed in Müller's fluid, Ehrlich's fluid, formalin, and in Weigert's chrome alum solution. Sections were cut by the freezing method and stained. The staining was done by the following methods: Weigert's osmic acid and hematoxylin, Mummery's iron and tannin, iron and hematoxylin, Freund's gold, Underwood's gold, and lemon juice and gold.

Weigert's stain for medullated nerves was used on tissues hardened in Müller's chrome alum, and good results were obtained with both Müller's and formalin hardened tissues, the medullated sheath of the nerves taking the stain.

The osmic acid method was used similarly to the above, and gave good results following Weigert's chrome alum solution.

Mummery's iron and tannin, used after Müller's fluid, stained the nerve fibers. but the results were not so good as with the two previous stains. Mr. Howard Mummery, however, has been able by this stain to trace fine nerve fibers from the nerve bundles.

Iron and hematoxylin gave good results, the fibers in some places being traced to the apex of the pulp.

Of the different gold methods, Freund's has given us the best results, although some of the results of staining tissues hardened by all the methods have been good.

In a general way, pathologic conditions of the pulp were demonstrated—vascular changes and circulatory disturbances, thrombosis being very common, as also embolism, because of the vast number of loops and want of expansion; endarteritis obliterans, and arterio-sclerosis. These diseases are based, in a measure, upon pulp-embryogeny, anatomy, environment, and to the end-organ nature of the pulp, as already stated.

Some years ago* I demonstrated the nerve endings in the coats of the bloodvessels of the pulp, showing its vasomotor system. The sympathetic system in disease, therefore, must play quite a part for good or evil in nerve endings and bloodvessels of the pulp. In a later paper† I demonstrated Wallerian degeneration and nerve sclerosis, showing that changes in nerve endings and nerve tissue involve the pulp.

As a result of disease of the bloodvessels and nerves of the pulp with external influence, there are retrogressive changes of inflammation: abscess, cloudy swelling, fatty degeneration, mucoid, colloid, hyaline, amyloid degeneration, pulp-stones, spheritis, neoplasms, fibroma, etc. Some of these conditions have been discussed by Wedl, Tomes, Smale and Colyer, Hopewell-Smith, Black, Bödecker, Arkövy, Andrews, Römer, Morgenstein, Caush, Latham, and many others, whose details can be studied at length in the original monograph.

It now remains to demonstrate what relation the pulp bears to tooth-structure and tooth-resistance. I cannot do better than quote at length from a paper entitled "The Vital Action of the Dental Pulp," ‡ by the well-known scientist, Dr. R. R. Andrews:

"When the tooth is fully formed, the principal function of the pulp is for vitalization of the substance of the dentin, by means of its fibrils, which permeate into every portion of the matrix of the dentin. Its function is not only to vitalize, but it may again assume its formative function whenever causes for repair demand this. . . . We cannot look on its tissue in life; . . . conclusions must be drawn from what is shown to have taken place when the tissue was alive; the living pulp, with its bloodvessels and nerves, nourishes the dentin; vital changes do take place, and the pulp is the source of vital action. It is a living organ, subject to any physiologic or pathologic process which may act on any living matter; its connection with the general economy must be similar to that of other tissues. It will respond to the action of returning health, and caries which has commenced has been arrested by this vital action, appearing as polished blotches on the teeth, which are not uncommon. Professor Miller, in his work on 'Micro-Organisms of the Human Mouth,' calls this condition a spontaneous healing of dental decay. The dentin, which had become softened, has become hard again, and the decaying process is stopped. This change also takes place in the temporary teeth. The healed dentin retains its discolored appearance, but becomes nearly as dense as normal dentin. These changes have been brought about by vital action, and this action came from the agency of the pulp.

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* *Journ. Amer. Med. Association*, December 19, 1903.

† *Dental Digest*, December 1903.

‡ Read before the American Medical Association, Section on Stomatology, at Atlantic City, June 7, 1904.

"When the dentin is irritated by infection or its surface is uncovered by a break, there immediately follows a period of vital activity. If sections of a tooth made when these changes are taking place be examined, the formative cells in that portion of the pulp nearest the point of repair are found filling up with glistening globular bodies and the tissue about it is showing an increased vascularity, as though active formative action were taking place."

Andrews was satisfied that these appearances were the result of the vital action of the pulp in its efforts to repair the tissue and that the minute glistening particles within the canals were in many ways similar to the minute globular bodies found in the tissues while the dentin matrix was developing.

"The protecting consolidation is found in teeth that are worn down, usually in the mouths of old people, and when this change has taken place these teeth are not liable to decay again, except under very favorable circumstances. . . . These changes are due in a large measure to normal conditions as regards the vitality of the individual; but in cases where the constitutional condition is below the normal, even where conditions seem favorable to decay, there is always an attempt made to retard the infection. Under certain conditions of environment and infection, penetrating decay is so rapid that the vital action of the pulp is overwhelmed, and the pulp becomes exposed and is in a pathologic condition even before the breaking away of the cavity walls.

"The pulp is the central and largest source of vitality to the tooth, and it acts through its myriads of fibrils. . . . Pain of the dentin following the touch of an instrument or from any irritation is exposed through the agency of these fibrils, and we become conscious of the sensation through them. . . . The dentin is and was meant at all times to be a living tissue. It receives impressions of injuries and responds by processes of repair. Some of the ablest men in the profession have questioned the further value of the tooth-pulp after the full formation of the tooth has taken place. They look on it simply as a formative organ and consider its mission closed with the formation of the tooth. It is, therefore, in their judgment quite as well to destroy it, take it out, and fill its chamber. The microscopic appearance of dentin after the pulp is removed shows that a large amount of dead organic tissue is left within the canals that cannot be taken out, and the dead tissue is a source of considerable danger to the health and vitality of the pericementum. . . . With death of the pulp, not only is sensation in the dentin lost, but also all the changes which vitality gives to an organ, such as nutrition and recuperation. These can never by any possible means be revived. . . . In cases of a lessened vitality we may expect more or less pericementum trouble, a darkening of the tooth, a recession of the gums, and an absorbing of the alveolar processes. The tooth is beyond the influence of any systemic process, and there is no probability of a change for the better."

Many of the facts here depicted by Dr. Andrews have been observed by most practitioners. The vividness of the portrayal of the vitality of the pulp must be appreciated by all. If under certain conditions the pulp can take on recuperative power at any period of life, retrogressive changes must also occur under certain conditions.

In summing up, it is clear that owing to the evolution of the face, jaws, and teeth, the teeth are naturally prone to degeneration (decay, erosion, abrasion, and discoloration). While the law of the survival of the fittest, so far as general health, obtains, evolution and degeneration of the teeth are progressing, slowly but surely. The influence of taint and disease are carried with the teeth from generation to generation. The chances for recuperation of tooth-structure by the inheritance of better blood-making are not so great as in the case of other structures of the body. The tooth has always been a very variable factor in evolution.

In somatic diseases, in metal and drug poisoning, in pregnancy, as well as in pulp-disease itself, vital action of the pulp is involved. Vital changes take place, the fibrils become diseased, tooth-resistance is lost, discoloration and softening of tooth-structure occur. Friction wears away the teeth, and, owing to want of tooth-structure, lactic acid ferment causes rapid tooth-decay.

Discussion.

Dr. James Truman, Philadelphia, Pa. I think we can all honor Dr. Talbot for his work in this as well as in other directions. I agree with him, however, only in a certain portion of his paper. I recognize the fact that neurasthenia, faulty metabolism, auto-intoxication, and everything that goes to injure the general organization are predisposing causes of abrasion and erosion. I cannot agree, however, with him that the pulp, as an end organ, becomes so far diseased as to produce caries in teeth. I have seen but two cases in which destruction or degeneration of that end organ could have produced destruction of the tooth-structure independently of external injuries, and I did not consider that in those two cases it was caries as this is understood.

His other proposition, that erosion can take place in the mouth without any acid action, has certainly to my mind yet to be demonstrated. I have never yet seen a case of erosion or abrasion in which acid action could not be demonstrated, or in which there was no possibility of acid action.

"Erosion" and "abrasion" to my mind are almost synonymous terms. Dr. Talbot makes a distinction between the two, and there seems to be a foundation for this as he describes it. Abrasion could not take place, nor would it be possible save in only the most limited degree, by the mere coming together of two structures in mastication. That action would necessarily be very limited, so much so that it would scarcely be recognized except as a slight loss of substance.

We must recognize the fact that there are two active destructive processes going on in the mouth under the conditions of abrasion. First, acid action, and secondly the attrition that carries away the tissue as it is worn away. I do not believe that this result is produced, except in rare instances, by a single action. A case presented at the University of Pennsylvania, under the care of Dr. Kirk, where there was no attrition at all, and he demonstrated that the destruction of the teeth was the result of altered oral secretions and was not due to neurasthenia or nerve degeneration.

I think it can easily be demonstrated that erosion is the result of acid action, although I do not pretend to say what acid. The ordinary treatment that we are prepared to give in such cases demonstrates therapeutically that it is an acid action that we have to deal with. I have had many cases of that kind where I have caused the erosion to cease absolutely for a number of years by the use of an antacid, such as the use of a magma of prepared chalk on the teeth at night.

In some of the children who have been under my care I have found it to be unquestionably true that the mucous follicles of the upper lip were more directly the cause of the destruction of teeth upon their labial surfaces, and in after years in the production of erosion, than all the degenerative influences that could be brought to bear upon them.

I am therefore not disposed to believe, with Dr. Talbot, that erosion and abrasion can be altogether due to the causes he has enumerated—although I hesitate to oppose him in this matter. Abrasion as a rule is due to a dual action—acid action and attrition—although there are exceptions.

Dr. W. D. MILLER, Berlin, Ger. Dr. Talbot has cited a number of cases in which caries of teeth appeared very suddenly and in which the teeth had previously been healthy. In these cases a state of general caries came about within a few months. He has attributed these sudden changes to constitutional causes. Such cases are familiar to us all in our daily practice. I have been of the opinion that the change could be accounted for by some local disturbances—if those disturbances could only be discovered.

About a year ago a colleague of mine suggested that he would like to bring a patient to me for consultation. He stated to me that she was suffering from nephritis and tuberculosis and was in a very poor state of health. Her teeth were formerly in average good condition, but within the year they began to decay rapidly, not only on the approximal surface but as well at the necks and on the margins of fillings. I immediately set about to examine her saliva. I gave her a glass and a pledget of cotton to chew upon; but no saliva came. I asked her if she suffered from dryness of the mouth, and she said she had done so for a year or more. There I had the cause of the decay in that case. It was not due to either nephritis or tuberculosis, but simply to the fact that she had no saliva, and therefore particles of food remained adherent to the teeth, and the acid resulting from the fermentation of these particles not being diluted by the saliva, acted upon the teeth in full strength.

In looking up the literature of the subject I have found a number of cases in which rapid decay has been incident to the cessation of the salivary secretion.

I am of the opinion, as I have stated, that many of these cases of sudden tooth-decay may be explained in this way by some local causes. A patient who had been under my observation for many years, during which time his teeth decayed comparatively little, suffered from a stroke of paralysis and was unable to clean his teeth. Food lodged between them at the necks, and when he came to me I could detect a smell of strong acid fermentation in his mouth. His teeth decayed about as quickly as I could fill them. But the decay was not due to the paralysis, but to the fact that he could not clean his teeth as he had previously done.

In regard to erosion, I am not convinced that an acid is necessary to bring it about, but that it may result from mechanical factors, either alone or in combination with chemical agents which possibly have a neutral or alkaline reaction.

I have been working for over a year in the attempt to produce erosion artificially by applying dilute organic acids to the teeth and brushing them alternately. I get, of course, a certain action on the enamel, but when I dry the tooth it looks white and powdery and never perfectly smooth as in erosion. Try putting acid on the enamel and brushing it alternately, then dry it, and you will not have a polished but a chalky and rough surface. Not only that; I have found that acid retards the action of the brush on dentin. If you take a piece of ivory and suspend it in dilute acid or in fermented solutions so that half of the piece is acted upon by the acid, and take it out every day and brush it, using a coarse tooth-powder on the brush, you will find the part of the ivory not acted upon by the acid will brush away more rapidly. That is, the decalcified dentin is brushed away more slowly than the sound. So also is it with all tough, leathery substances; you might grind all day upon a piece of rubber and not grind it away, but a hard brittle substance would be ground away.

I doubt the possibility of a tooth that has become hard subsequently degenerating by internal causes. I believe that a tooth becomes harder with old age, but I am not convinced that it becomes softer.

Dr. M. L. **Rhein**, New York, N. Y. Mr. Chairman and gentlemen, I think the paper of Dr. Talbot is an important one, for I believe the question which he has brought up is one which has been too much overlooked by the profession since the notable scientific discoveries of Dr. Miller, which have demonstrated so plainly the local and what I should call the exciting cause of caries.

Now, I have not taken Dr. Talbot's paper in exactly the same sense as the other gentlemen have. I do not know whether I judge him rightly or not, but I believe when he refers to the constitutional causes of decay, he means the *predisposing* causes of decay. In other words, a tooth has a natural resistance to the various bacilli in the mouth when the patient is in a state of health, and so great is this resistance that it is impossible for caries to exist. The very cases that have been cited by Dr. Talbot, Professor Miller, and Professor Truman, I will cite to you as evidence in substantiation of the theory brought up by Dr. Talbot. These are cases where fillings have preserved the teeth for a certain length of time, and then when the patient is subjected to some constitutional disturbance we suddenly find the ravages of caries proceeding rapidly. It is not meant by this that the constitutional disturbance is the direct exciting cause, but without this constitutional disturbance as a predisposing cause, the exciting causes—the various bacilli—would be unable to produce their effects.

This is my conception of Dr. Talbot's paper, and I agree with him in this; I go perhaps a little farther: I believe that the various serious constitutional disturbances manifest themselves in the mouth in different ways according to the character of the trouble that is producing the various forms of malnutrition.

I do not want to go extensively into this subject, but my own opinion is that there is a large field open to the profession in this direction. In other words, I believe that the mouth symptoms are very strong indications, if carefully observed, as to what is wrong in the system generally.

As to erosion, I agree thoroughly with Professor Miller and Dr. Talbot in this respect. I do not think that an "acid condition," as we ordinarily speak of it, has anything material to do with it. In all these cases, to a certain extent the conditions found in the oral solutions vary from time to time. They may be acid during one portion of the twenty-four hours and alkaline at another. I believe the point we should consider is that the mucous follicles are in a pathological condition.

The CHAIRMAN. I think it might be better, Dr. Rhein, if you would defer discussing the specific question of erosion until Dr. Ottofy has read his paper on that subject.

Dr. RHEIN. Then I simply want now to call the attention of the section to the distinction which should be made in speaking of this subject between the exciting cause and the predisposing cause. This being understood there will be no difficulty in understanding—as Professor Miller has elucidated—that bacilli may be present and yet caries be an impossibility.

The CHAIRMAN. I would also suggest to Dr. Talbot that it would perhaps be better for us to hear Dr. Ottofy's paper, and then he could close the discussion together with Dr. Ottofy.

Dr. TALBOT. Certainly.

Dr. LOUIS OTTOFY, Manila, P. I., then read his paper entitled "Observations on the Causes of Erosion," as follows:

Observations on the Causes of Erosion.

By LOUIS OTTOFY, D.D.S., Manila, P. I.

In a brief paper which I presented before the Third International Dental Congress in 1900,* I called attention to a possible cause of erosion—as it was my privilege to observe it—due to the retention in the system of some of the constituents of excreta, or to the introduction of those substances, in a partially fermented or in an unfermented condition, as the result of customs and practices which prevail in the Orient, within my field of observation in China and Japan. At that time my observation on this subject was confined to the people of Japan, natives and foreigners alike. Since that time the views I then formed find additional confirmation as the result of over four years' observation in the Philippine Islands.

"ORIENTAL EROSION."

Common erosion, as it is generally recognized, resulting in the V-shaped destruction as well as the concave form usually recognized by writers on the subject, is in the Orient supplemented by a form which I have no recollection of ever having noticed during my residence in the United States. It consists in some instances in the erosion of the incisal edge of the incisors, while in others I have seen the destruction of the labial surface of incisors, until half of the tooth had been destroyed, the resultant discoloration showing the outline of the enamel, dentin, and calcified obliteration of the pulp-chamber.

In order to insure a better understanding of the subject on the part of those not familiar with the customs of the East, it will be necessary to explain such of the prevailing methods as have a direct bearing on this matter. As is well known, Japan and China support an immense population. As regards China, the indefinite knowledge of the number of her population and the obscurity of data on the point of her tillable soil makes it impossible to give any reliable information as to the number of people supported by a given space of soil. It is, however, well known that the teeming millions of the Flowery Kingdom use every available acre for the support of her people, and the exportation of farm products which yield better financial remuneration as items of export than as food for home consumption is very meager.

In Japan, as regards statistics it is otherwise. Her population amounts to nearly fifty millions, while the more than six hundred islands of the empire embrace 147,000 square miles, or "equal to the single state of Montana," and "of this less than 19,000 square miles are arable land. If all the tillable acres of Japan were merged into one field, a man in an automobile, traveling at the rate of fifty miles an hour, could skirt the entire perimeter of arable Japan in eleven hours."* These few acres not only feed a population of nearly fifty millions, or more than half of the population of the United States, but, while Japan also exports foodstuffs such as rice, potatoes, onions, etc., its combined imports of food and fertilizers more than balance the sum total of the exports. Hence it is safe to assert that nearly fifty million people receive sustenance from territory no larger than the states of New Hampshire and Vermont. This necessity of overworking the soil has resulted in the exhaustion of its productive virtues, which in turn has led to the necessity of free and extensive fertilization. By reason of the scarcity of domestic animals, such as horses and cattle, due in fact to the greater value of the limited soil for the production of food for man rather than for grain and forage animals, leading to an absence of manure for fertilization, the excreta of the alimentary canal and the secretion of the kidneys of man—which in less populous countries finds its way into the depths of the soil and the rivers and streams—assumes in Japan and China extensive value as a fertilizer.

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* Third International Dental Congress, Paris, France, 1900. *Comptes rendus*, t. iii, p. 264.

In these countries, therefore—excepting limited foreign communities and modern buildings in large cities—all excreta and urine is carefully collected and transported to the farming lands. To see this custom among the Japanese it is only necessary to live in a city like Yokohama or Tokio. In the former, beginning at about 5 A.M. daily, the principal roads leading to the country are teeming with men and women with bamboo poles over their shoulders, carrying a wooden bucket of excreta at each end; others are pulling carts containing four, six, eight, and more of the same kind of vessels, women and children pushing the carts, while here and there a native pony or a specimen of a diminutive species of bull carries two or four buckets on his back, all hastening to the farms. There the products are stored in large tanks and barrels buried in the ground and used as occasion requires for the fertilization of rice fields, vegetable gardens, and indeed for the support of all useful vegetation. In thinly populated sections these excrements often have to be brought some distance from more thickly populated centers, and the quantity is frequently so limited and the demand so great that it has to be used at times before the processes of fermentation are more than partially completed. In other words, vegetation is forced to its utmost capacity with human excrement and urine almost immediately after the same has been voided from the human system.

That this practice is deleterious has been recognized by the agricultural scientists of Japan. The writer just quoted has the following to say on this point:

"The secret of the agricultural success of Japan has been a mystery to many students of nations. Progressive experts of high authority throughout the Occident now admit that in all the annals of agriculture there is nothing that ever approached the scientific skill of Japanese husbandry. Although the United States has extensive experimental farms—the Arlington station at the national capital alone comprising five hundred acres—and although our Department of Agriculture includes a corps of skilled and successful investigators, some of them enjoying international repute, the American government has turned for instruction in a number of essential principles to tiny experimental patches in Japan, where native scientists studying agricultural problems through the lenses of the microscope are making discoveries of world-wide importance. Our experimental farms number fifty-six; Japan has nearly two hundred. Yet the combined area of those island stations is not equal to the single farm America maintains at Washington. The main experimental station in Japan is regarded in that country as a very big affair. Big it is in importance—and, from the Japanese standpoint, extensive in area. It is located in the suburbs of Tokio, and comprises a trifle less than six acres.

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* Harold Bolce, in August 1904 issue of the *Booklovers' Magazine.*

"On this small field Japanese scientists are wresting from the soil and from the vegetable kingdom secrets utterly unknown to western nations. American and European agricultural explorers have sought repeatedly to get facts in regard to the achievements of these Japanese investigators. But the Japanese government does not wish the West to share the fruits of its advanced researches. So pronounced is the opposition that an eminent American scientist, learning that I was to visit the experimental stations in Japan, invoked my assistance in securing certain information, stating that an effectual embargo had been placed upon his official efforts in that direction. Thus the experimental farms, like the arsenals and harbor fortifications in Japan, have been included in the forbidden."

Mr. Bolce's article, from which the foregoing is quoted, has nothing to say on fertilization with human feces and urine. As his article is for a home journal, all reference to this phase of the subject is excluded. It would be interesting to learn this observer's views on this topic, and he may possibly know whether the more recent scientific investigations have revealed the injurious nature of vegetable growth thus induced, and to what extent, if any, those investigations have either proved or disproved the arguments set forth in this paper.

The diminutive stature of the Japanese race is in a measure attributed to this cause, and is possibly aggravated by the Japanese custom of sitting with the legs folded under the body; this custom, it is claimed, tending to hinder the development of the lower limbs.

Unfortunately, neither chemical analysis nor any other method of investigation will yield up the secret of the difference between rice produced from normally fertile soil by nature's unaided processes and that produced by the aid of artificial fertilization with unfermented human excreta. It is recognized that a difference does exist, and that the result is in favor of the normally produced vegetation.

Crops of garden produce, such as onions, radishes, lettuce, cabbage, tomatoes, etc., are grown in rapid succession in Japan, and in some sections continuously throughout the year. It almost seems that the soil is merely a medium of dilution, and the excrement the source of production. In traveling about the country one can see the farmer in his field with a bucket in one hand and a wooden dipper in the other, fertilizing the rice fields and throwing the material freely over the sprouting vegetables.

While it is generally accepted that plants will select from the soil and from the media into which their roots extend only that which is necessary for the development of each of them, it has also been demonstrated that plant life, not unlike animal life, is susceptible to artificial influences of various nature. Thus, certain coloring matters and volatile substances possessing odor are taken up by plants to which such materials are unnatural, their presence being recognized either by their color or smell. It is therefore possible that substances found in fecal matter the knowledge of whose chemical composition is still more or less shrouded—such as indol, phenol, skatol, etc.—may be taken up by the plant.

I feel more convinced of the probability of some such influence since my residence in the Philippine Islands. The Japanese and the Filipinos belong to the same race, and their mode of life—in regard to food at any rate—is almost identical, except possibly that in the Philippines even the poorest of the people sometimes add the meat of fowl, hogs, and carabao to the universal diet of rice and fish which is the staple food of both countries.

In Japan, erosion is quite prevalent among the natives, while foreigners are usually affected after long residence in the Islands. Foreigners, in course of time, develop a fondness for rice, which thereafter becomes a constant constituent of their food, as well as the forced vegetables, some of which are raised especially for the consumption of foreign residents. I have seen many persons who have resided for over fifteen years continuously in Japan, and almost without exception the teeth of these foreigners were more or less attacked by erosion. In the case of a gentleman who, some forty years previous to the time I knew him, was instrumental in persuading the Japanese government to open ports for the settlement of foreigners, the condition was unusually well marked. The delicate mission of this gentleman, at a time when open hostilities existed toward all "foreign devils" in Japan, obliged him to assume the garb, follow the life, and eat the food of the Japanese.

It having been recognized that the improper elimination of uric acid leads to certain systemic disturbances, and possibly is a remote or contributory cause of erosion, in like manner it is possible that the introduction of the volatile active principles of the products of decomposition may have some influence in producing this form of erosion, which may aptly be designated "oriental erosion" (*Erosio orientalis*).

On the other hand, the consumption of an unvarying diet, largely vegetable, and produced under the conditions described, may lead to the presence of a superabundance of the volatile products of decomposition and their absorption through the walls of the lower portion of the large intestines, thus forming a constant constituent of the blood supply. That this is true of the action of the kidneys is an established fact; namely, that products of retrograde metamorphosis which should be and are normally eliminated by the kidneys, are, under abnormal conditions (or by the introduction of an overabundance of foodstuffs whose digestion and absorption lead to products eliminated by the kidneys), retained in the circulating medium and eliminated by the salivary and sudorific glands.

"EROSIO ARECA" (BETEL EROSION).

In a paper read before the Manila Medical Society, September 7, 1903, and published in the *Dental Cosmos* for December of the same year, I made brief reference to the recognition of a peculiar form of erosion which I observed among the Filipinos, due to the chewing of the betel nut, which is a common custom of the East, including Japan, China, the

Philippines, the archipelago stretching along the Straits Settlements, Burmah, Siam, India, etc. As far as I am able to ascertain, to its use is ascribed a stimulating effect similar to that produced by tobacco. It is said to be an aid to digestion, and the impression prevails that it is a preventive of derangements of the alimentary tract.

The following products enter into the composition of a "chew" of betel: A leaf of the buyo tree (belonging to the *Piper* class), weighing about ten grains; a slice of the areca or betel nut, weighing about twenty grains, and from three to five grains of slaked lime.

The leaves are selected and washed; the lime is placed upon the leaf, and the latter is folded until the result is a ribbon about one-third of an inch in width. The nut is deprived of its outer covering and is cut into disks about one-twelfth inch in thickness; a disk is then surrounded by the folded leaf containing the lime, the ends of the ribbon of leaf being tucked in so as to embrace the disk of areca nut. I was informed by laboring men in Manila that they consume from eight to ten of these potions in the course of a day, at the cost of about two cents or less of United States currency.

The juice produced by mastication is of a brick-red color, and when expectorated has the appearance of being curdled. It causes a dark-colored incrustation to become firmly deposited on the surfaces of the teeth, which becomes embedded in all crevices, irregularities, or deformities of the enamel, and in so far is a preservative, seeming to impart an appearance of density to the enamel. On the other hand, a recession of the gums takes place after buyo has been used for some years, and the further practice of resting the "quid" in the vestibule of the mouth between the cheeks and molars results in extensive destruction of the soft tissues, absorption of the alveolar process, and loosening and final loss of the teeth. Furthermore, when recession has taken place and the pericementum has become exposed, the discoloration becomes deep-seated and is impossible of removal without injury to the teeth. These are the usual effects upon the teeth and the soft tissues of the mouth.

Pride often leads to the abandonment of the practice, especially in young women, or at least to the removal of the stain and deposit; with resumption of the practice, repetition of attempts to remove the stain, etc. For this purpose a smooth stone resembling sandstone is used, polishing the surfaces of the teeth, resulting in the removal of the enamel. But when this practice has been resorted to it is easily recognized; first, by the fact that the attempt has not been carried as far back as the molars, and secondly by the flattening of the labial surfaces of the teeth from the cervical margin down and including the incisal edge. In other words, the liability to injure the gums, and the impossibility of reaching the cervical margin with a rough stone without injuring the gums, results in leaving a shoulder at that point, but from there on down to the incisal edge the friction is freely exercised, so much so that the incisors at the incisal edge are often very thin, while the canines are brought down to a sharp point. This is simply mechanical abrasion.

Contrariwise, the erosion produced as the result of the use of betel creates a concavity on the labial surfaces of the teeth, the molars included, the incisal edge not being thinned as in those cases where friction is resorted to. Even then I was in doubt, after careful interrogation, as to any effort ever having been made to remove the discoloration—in which case I was under the impression that a more or less careless attempt to remove the stain resulted in causing a concave surface instead of a flat one down to and including the incisal edge. But I have seen the lingual and palatal surfaces of the molars and bicuspids attacked in the same manner, and in positions where it would have been impossible to produce the regular concaving of those surfaces by any mechanical means, unless it were done with a disk or wheel used in a dental engine in the hands of a skilful dentist. I can see no other cause, either in the general health, the food, or the method of living of the Filipinos, to produce this peculiar form of tooth-destruction; and its entire absence in those not addicted to the use of the betel nut leads me to believe that this form of destruction may justly be designated as "betel erosion."

Discussion.

Dr. G. W. Cook, Chicago, Ill. Something like a year ago there were begun in Chicago a series of investigations and observations on erosion. The results of that work we are not at liberty at the present time to detail. But Dr. Rhein, I think, has brought out very forcibly the difference between the active and the predisposing causes not only of tooth-decay, but of all diseases of the human body or of the lower members of the animal kingdom.

There are many considerations in regard to the changes in the metabolic processes of the human body. A chilly wind may produce a marked change in the metabolism of many individuals. Marked differences in metabolic processes have been produced by feeding animals in different temperatures. We know by experiment that the metabolic changes in the lower forms of life due to changes of environment are of great importance in the study of scientific subjects, and Dr. Ottofy's interesting observations open up a vast field of research. Now these changes, so-called "constitutional," are due to so many phases that it would be impossible and out of place to go into details now. But I do believe that the majority of what we designate as constitutional causes are due to some modification of the nutritive function of the alimentary tract.

Ading and other experimenters have shown that if the intestinal tract be ligated in any part of its course, the absorption and transmigration of bacteria will take place, and pathological excretions will also pass through the walls of the tract. I am therefore inclined to believe from my experience with the cases that have come under my care that nine-tenths—perhaps that figure is high—of all our local conditions usually attributed to constitutional causes are really due to some nutritive error, either over-stimulation or under-stimulation of some portion of the digestive tract. And when changes have taken place in the constitution of the individual necessarily there is a changed condition of the excretions and secretions of the body, both chemically and physically.

This subject of erosion is one that will be divided into a number of classes. I have been very much interested, and I wish to accord to Dr. Miller the greatest possible honor, because I feel he has attached a wire to me that makes me keep at work as soon as I begin to flag. He made a number of important statements in an article published in the *Cosmos* for March 1904 on the subject of "Erosion." But, in regard to all these conditions, we as dentists must look clearly for the local causes in each particular individual that we are called upon to treat.

Dr. MILLER. In the cases mentioned where the calcium carbonate was constantly made use of, the acid would be neutralized thereby, would it not?

Dr. OTTOFY. Certainly.

Dr. MILLER. I think that that would be a proper deduction. I would also like to ask what the animals eat there, and whether they show erosion also?

Dr. OTTOFY. I have not investigated that question.

The CHAIRMAN. If there is no other discussion I should like to have Dr. Rhein continue from where I interrupted him.

Dr. RHEIN. For many years back I have had the same idea of erosion as that stated by Dr. Ottofy in a very simple sentence: If the kidneys or some other organ of the body do not eliminate a certain amount of material, then the burden may fall—not, as I remember he said, upon the salivary glands; I differ with him there—but upon the mucous follicles, thereby becoming productive of erosion.

His description of the manner of nutrition of the Japanese demonstrates to us the limited variety of their food and the consequent effects which he describes suggest a strong correlative with the disease known as infantile scorbutus. I would like to call your attention for a moment to that disease, which has only been understood during the last fifteen or twenty years. It is intimately related to scurvy, and is produced only when a child is fed upon a certain form of milk which does not bring enough nutritive elements into its system. One of the results is the destruction of the entire enamel matrix of the teeth. The teeth are destroyed through pathological conditions which are clearly discernible in the oral secretions. It struck me that the Japanese form of erosion described in the paper bears a strong relation in that way to infantile scorbutus.

I want to call your attention to another fact. We have heard a great deal during the past few years—and I believe it has been to the advantage of our patients—of the value of the attention which we give, in the preservation of the teeth, to keeping the mouth in a condition that is as near the normal type as possible; that is, to encourage the absolute cleanliness of the mouth, and to teach the patient to maintain it.

My deduction is clinical, but it is well established in my own mind that if the capillary circulation in the mouth be kept in an active condition there will be a resistance to morbid conditions, which will not be able to manifest themselves.

I should like to explain this by stating that in erosion—in progressive erosion, where I am able to realize that the ravages of erosion are going on—I have over and over again stopped that process by the stimulation of the gum tissue about the teeth where the mucous follicles are present in large quantities, and by obtaining as nearly as possible a sterile condition of the mouth. In this treatment I have resorted to various forms of stimulation of the capillaries, such as the orange-stick, or calling to my aid various forms of force—electricity, vigorous massage, etc. That I have been able in this way to stop what I may call progressive erosion gives me reasonable ground to say that the cause of this erosion lies in the fact that there is an elimination through those portals of effete material which, if it were eliminated in some other portion of the system, would not be productive of this result. It is simply this point that I desire to call to your attention. (Applause.)

Dr. EUGENE S. TALBOT, Chicago, Ill. I was very much pleased by the remarks that were made by Drs. Truman and Miller, and more particularly with the remarks of Drs. Rhein and Cook. I appreciate the points that they made, and I agree with them thoroughly. There is no question in my own mind, and I believe everyone will admit, that the necessary local conditions are friction and acidity. I do not see how there can be anything else. Dentists do not go far enough in any particular medical branch of dentistry.

I do not see how it is possible for a man who has been in perfect health until he is forty-two, and then is taken down with a disease—whether Bright's disease, pneumonia, tuberculosis, or any other disease where the entire system is involved, as a result of local disease—for the teeth to remain perfectly normal. There are periods in the lives of every individual from the time the first teeth erupt until they are lost when they become stronger and harder. Now, if this be true, the reverse must also hold good. If a structure can be built up by the system becoming stronger, necessarily by disease the structure must also become weaker.

We have learned more about the nervous system in the last ten years than before; indeed, all the text-books written on that subject ten years ago are of little account today. Fortunately I was just getting along to the point of studying the nervous system when our new methods and stains came into use. I have traced the relation between the bloodvessels and the nerves, and I have demonstrated—as other scientists have done in the body elsewhere—nerve and pulp degeneration. If other tissues become diseased in this manner, the pulp must also be a most favorable organ for the same process.

What Dr. Ottofy told us was new to me. I believe he has confirmed to a certain extent the views I have stated. I placed the subjects of decay, erosion, abrasion, and discoloration under one head because I believe they are all influenced in the same manner, the only difference being the locality. Each subject is large enough for a paper by itself. I can show many cases in which the color of the teeth has changed, the enamel has softened, and decay has gone on rapidly as the result of a systemic condition. The very beautiful illustration of Dr. Rhein further tends to clear up this subject.

The CHAIRMAN. I would like Dr. Eugene S. Talbot of Chicago to take the chair while I take part in the discussion.

Dr. Talbot accordingly then took the chair.

Dr. R. H. HOFHEINZ. An instance occurring in my practice some seven or eight years ago illustrates the nervous influence in these so-called constitutional cases. I had attended to the teeth of a lady probably thirty-eight years of age, and at that time I considered her mouth in perfect condition; there was not the first sign of erosion. There had been some decay which was taken care of in the usual way. About six months after that I received a letter from my assistant saying that the patient had called at the office and complained of sensitiveness of her anterior teeth. I wrote my assistant that the patient should consult a certain practitioner known as having great diagnostic abilities. She went to see him accordingly and he said it was a case of erosion. The case continued so far as I can remember for at least seven or eight months more. I wrote to her physician to examine her saliva, and it was found to be strongly acid. I have every reason to know that the patient was at the time under very serious nervous strain, that was all, and her physician wrote me giving the details. It was nothing but a neurasthenic condition, and the erosion lasted about fourteen to sixteen months. I took impressions of the teeth and found that some had eroded fully a millimeter in depth. At the end of that time the neurasthenic condition had ceased, and the erosion ceased with it.

I believe we have so many constitutional factors to consider which may express themselves in local manifestations as has been stated, that we should always look for possible constitutional influences.

Dr. Ottofy is not present, so we cannot have him close the discussion.

On motion, the section then adjourned to meet next day, Tuesday, at 2.30 P.M.

SECTION II—Continued.

SECOND DAY—Tuesday, August 30th.

THE meeting having been called to order at 2.30 P.M. by the chairman, Dr. Hofheinz, the minutes of the previous meeting were read by the secretary, Dr. Rhein, and approved.

The paper by Dr. SAMUEL A. HOPKINS, Boston, Mass., entitled "Application of the Results of Research Work to Daily Practice" was then read by the secretary, Dr. Rhein, as follows:

Research Work and its Application: The Application of the Results of Scientific Research to Problems in Daily Practice.

By SAMUEL A. HOPKINS, M.D., Boston, Mass.

IN the profession to which we have the honor of belonging we meet with a class of men who boast of the fact that they are practical. These are frequently men of rare manipulative skill and of great mechanical ability, and in a profession calling for the hourly use of marvelous dexterity and in which much of the time is occupied in restoring impaired teeth to usefulness or in replacing lost teeth with artificial substitutes, such men deserve and secure a large measure of success. Too frequently, however, the boast of being eminently practical is but a cloak to cover the inertia or indisposition which renders an individual unable or unwilling to follow the advance of students of science who are laboring unceasingly to thrust the reaping-knife of original investigation into the ripening harvests of human knowledge that surround us.

Those of us whose privilege it is to teach must frequently feel that among the instructors in our dental schools there is a division of taste and interest too marked for the well-being of the school, and a lack of concord which diminishes the force of our instruction, and makes it less readily available for the uses of the student. We frequently have on the one hand an excellent body of intelligent gentlemen teaching operative and mechanical dentistry, orthodontia, and prosthodontia, who have only a rudimentary knowledge of histology, pathology, and bacteriology, and who honestly feel that these and allied sciences have but little bearing on their professional work. Indeed, the very fact that, while they have wilfully ignored these subjects, they have nevertheless achieved success in building up a lucrative practice, is satisfactory evidence to them that such knowledge has no more important bearing upon their professional career than Greek archæology has to the work of an Hibernian laborer.

On the other hand, in many instances we are forced to depend for our teachers in the scientific branches upon men who have never studied dentistry. They are men of high attainments and are enthusiasts in science, in which they are completely engrossed. They are unable to point out the practical application of their wonderful knowledge to the daily problems arising in dental practice—if, indeed, they have not lost sight of the fact that the chief value of such knowledge lies in its ultimate application. Medical education presents the same picture. Pathology, for instance, was originally studied in order that the observance of morbid processes might lead to the discovery of some means by which the practitioner could thwart the disease which gave rise to such morbid conditions. Today pathology is studied for the sake of pathology, and its application to the needs of the practitioner is a secondary consideration—if it be not entirely lost sight of. Indeed, I recently heard a professor of this science in one of our great medical schools declare that the application of his work was never thought of, and that he preferred men as his assistants who had no knowledge of the practice of medicine.

Such an attitude as this on the part of a teacher in our medical or dental schools might easily tend to stultify any interest which the student might have developed in the study of the biological sciences, if such interest depended upon the application of his studies to the practice of his profession. The value of research work cannot, however, be estimated by the use which immediately follows its announcement. Indeed, it is highly probable that so far as the ultimate benefit to mankind may be considered, the position of the eminent pathologist to whom I referred is the best one that can be chosen; for it is quite conceivable that if a worker in the untilled fields of science should be oppressed with the nagging necessity of connecting all his results with some practical affair of daily life, his mental horizon would be wofully narrowed, and his limitations would be so great as to render much of his work ineffective. In our great anxiety for results, we are prone to lose sight of the fact that the very spirit which spurs a man on to profound investigation may chafe at the suggestion of the utilitarian who insists upon seeing a prompt application of every recorded fact of science. The study of science for science' sake is quite as inspiring to many minds as the study of science for its immediate bearing upon the problems of life. It must not be forgotten, however, that the storing up of scientific results could hardly be carried on with the enthusiasm which inevitably accompanies such work, were it not for the confident assurance that the time would eventually come when such results would be available for the needs of humanity.

A striking illustration of this principle may be found in the fact that the laying of the Atlantic cable was made possible by a mathematical formula worked out nearly half a century before transatlantic communication was thought of, and which had had no practical application until the problem of bringing the two worlds into daily communication with each other was suggested. It was then that Sir William Thompson, now Lord Kelvin, remembered the experiments of the French mathematician Fournier in measuring the rapidity with which heat travels along an iron bar. By the application of Fournier's formula to the great electrical problem which then engaged the attention of both countries, Sir William Thompson was able to assure the capitalists who sought his advice that a cable built according to the plans he indicated would be a positive success. The world has seen the vindication of Lord Kelvin's prophecy, and has had reason to be grateful to Fournier for recording a scientific fact that for many years had, seemingly, no practical application to the affairs of life.

For many generations chemistry has been storing up facts the application of which, in many instances, was extremely problematical. Physiology began to advance, and to avail itself of the results of chemical experimentation—of results which, in many instances, had been hitherto unavailable for any useful purpose. This union has resulted in the wonderful science of physiological chemistry, which already has delved deeply into the problems of vital existence, and which gives promise of leading us to the very boundary line of human knowledge, where the material facts of human life and human thought become merged in the unfathomable mystery of the spiritual. Instances are not wanting in medical and dental science wherein the investigations of scientists have been immediately followed by the discovery of a method of preventing or successfully controlling disease. Indeed, it may be confidently asserted that every advance from empiricism has come as a result of scientific investigation; and the most self-centered, avaricious seeker after commercial success will welcome with enthusiasm any scientific advance which simplifies his work or gives promise of increasing his income. It is, however. the other class of scientific work—that which is not immediately productive of utilitarian results—which is also worthy of our attention, for which I am now pleading. Research work which has no immediate application to the needs of the world may fail to hold the attention or to excite the applause of the average man of affairs who prides himself on being practical. Yet this same work may still be of utmost value in pointing out the road, and in clearing the way for some other investigator, who, with the start thus given, may successfully solve an important problem and reveal its bearing upon the world's work.

Indeed, if time allowed it would not be difficult to show that almost every piece of research work that has been of value in its application to human needs has had its inspiration in some other work which may perhaps have fallen far short of the practical requirements of mankind. To awaken an interest in science for its own sake in our profession would be to awaken a broader intelligence, to give birth to new and better ideals, and to break the fetters of concentrated application to routine duties which make dentistry the most exacting and narrowing of the professions. Without decrying the necessity of discussing everything that has a bearing on the successful filling of a tooth-cavity, I would suggest that a too frequent repetition of the old formulæ may narrow our intellectual horizon and dull our perceptions; and when such discussion degenerates to the point of recalling the mythical experiences of the Dumas of our profession, our politeness is taxed unfairly, and our time is unjustly wasted. Our politeness is taxed, because when a man recites successful operations performed by him, with the implied meaning that he alone could have performed them, and relates the marvelous cures that take place under his skilful treatment, we are all convinced that the speaker is romancing, but courtesy prevents our saying so, and indeed there is no way of proving the falsity of his statements. Upon the younger men the effect is discouraging, for they know that they themselves cannot achieve the exalted standard of skill claimed by such a speaker, and they have not learned to discount his claims. For these reasons I would plead that clinical work be performed at the proper clinic, and not in the imagination of those rhetorical romancers who mistake the courteous silence of society members for credulous belief in their impossible tales.

I would plead, too, for an interest in subjects not directly applicable to the daily operations of our profession, because such subjects broaden our viewpoint and develop a sense of values which the too constant riveting of our attention upon the point of an instrument is apt to destroy.

With this preface, and with an apology for bringing to your notice some unfinished work—and work which may be said to be unsuccessful in the fact that it has neither fulfilled my expectations nor revealed a field of application—I will call your attention to certain mouth bacteria which have the interesting property of producing mucin, and which may be found, on further investigation, to bear a causal relation to certain pathological conditions which we are repeatedly called upon to treat.

Mucin is a nitrogenous matter found in several of the tissues of the body, and notably in connective tissue. It is also found in several secretions of the human body, and in certain secretions of animals belonging to different species. It is, as you know, found in mucus, and its viscid consistence is so well known that it is scarcely necessary to dwell upon it. The fact that bacteria are capable of producing a gelatinous substance has been demonstrated by a number of bacteriologists, and both Dr. Black and Dr. Williams some years ago pointed out very clearly the association of this gelatinous substance with caries. And in this connection it is well to remember that all slimy products of bacterial activity are not necessarily mucin, and at the same time it will be well to remember that the production of mucin is not confined to a single species of bacteria. We have known for many years that even macroscopically, salivas of different individuals differ greatly, and we know also that the saliva of the same individual differs at different times and under different conditions of health. We have come to associate the stringy mucus-laden saliva with rapid carious action; and we have speculated as to the reason for this condition without receiving a satisfactory answer, except such as is found in the mechanical binding of the lactic acid-producing forms to the dental enamel walls by the gelatinous mass.

Those who have never made the tests would be somewhat surprised to find that this ropy saliva is usually quite alkaline in its reaction, and that in a majority of instances there is a copious flow, and that this flow sometimes becomes very excessive.

If we should carry our observations still farther, we would discover that this stringy saliva is a far better medium for the cultivation of bacteria than is a clear watery saliva, particularly if that thin, watery saliva be slightly acid in its reaction. In other words, bacteria multiply very much more rapidly in the thick, mucus-laden saliva which has marked alkaline reaction, than in the clear, watery product which has a neutral or a slightly acid reaction. An acid reaction retards bacterial growth, and is not usually associated with excessive carious action.

If we go still farther, and cause our patients to follow the Fletcher method of excessive mastication, we shall notice that the saliva undergoes a change, and that which was thick and stringy becomes much more clear, and is a less suitable medium for bacterial activity. This would indicate that the salivary glands, if stimulated in a normal way by proper mastication, are often capable of pouring out a perfectly healthy normal product in response to normal stimulus. An interesting problem in cytology is here suggested, which time will not permit me to discuss, but the fact may be regarded as established that healthy normal exercise produces healthy cell action resulting in healthy secretion. If we carried our observations still farther we might notice other peculiarities of the patients who secrete this ropy saliva which I have described. We would be apt to notice that these are patients who eat rapidly and who do little chewing, and that they belong usually to that type which we call nervous: but for our present purposes these observations are unimportant.

It has long been known that bacteria break up chemical compounds into simple elements, which unite to form other compounds which are frequently simpler and more stable than the original combination. We have come to regard this property which bacteria have of producing fermentation as being their special function, and we know that life itself depends upon it.

The refuse matter of the earth is decomposed and changed into suitable food for plant life by the action of these microscopic allies of humanity. In the human body proteids are split up into gastric digestive products by their action. Sugars are split up, and a number of acids such as acetic, butyric, formic, and lactic, are produced. Starches may be changed to sugars and fats split up into fatty acids and glycerin by the agency of bacteria; and it may be reasonably questioned whether life will not become extinct when the antiseptic which will sterilize the alimentary tract has been devised. It has been pointed out by Dr. Miller that the production of lactic acid in the human mouth cannot easily be carried beyond three-fourths of one per cent. because of the destruction of the lactic acid bacteria by the lactic acid which they produce, so that in all experiments on the destruction of teeth by acids we must take into account that the acid which produces the pathological changes in the teeth never reaches the strength of one per cent. Many bacteria are, in another way, victims of their own industry because they have the property of producing enzymes which are capable of digesting the organism which produces them, and sometimes other organisms as well.

I am fully convinced that upon this phenomenon will be found to rest the explanation of immunity from disease, and that the self-limitation of infectious disease finds an explanation in this theory.

If one of the pyogenic or pus-producing forms like B. pyocyaneus be grown for several days at the body temperature, there will be found a scum on the surface of the bouillon. If the tube be thoroughly shaken, and again placed in the incubator, at the end of three days a new scum will have formed. Repeating this operation each third day for about three weeks you will find a deposit in the tube of broken-down bacteria which fail to take the stain readily. Emmerich and Low explain this change by the development of an enzyme which first agglutinates and then destroys the bacteria. The bacteriolytic action is, according to Vaughan, the result of a digestive action upon the nucleo-proteids of the bacterial cell. There is some evidence that in the human mouth, which is never free from bacteria, enzymes may be formed which retard pathogenic activity, and it is not beyond the range of possibility that in the large number and variety of bacterial activity may be found compensating ferments which impose limitations upon the work of those bacteria that we have come to look upon as destructive to the teeth and to the health of our patients.

Mucin production is not limited to a particular mouth-bacterium. A number of forms, B. subtilis, B. coli commune, B. megatherium, and others, have the property of producing this substance. It is interesting to note that the many lactic acid-producing forms found in the mouth are not particularly active in the production of mucin, and this is a point to which I wish to call attention. While many of the lactic acid bacteria are capable of producing mucin, when not engaged in the production of lactic acid—that is to say, when growing in a medium free from carbohydrates—these same organisms in the presence of carbohydrates will produce lactic acid, and their mucin production will be reduced, if not entirely checked. An organism carefully studied by E. K. Dunham of New York produces mucin in large quantities in milk cultures, but does not coagulate the casein, at least for several days, and the whey becomes so slightly acid as to be hardly noticeable. Another peculiarity of mucin production to which attention was called by Leo F. Rettger, of the Sheffield Laboratory, Yale University, was that bouillon cultures became very slimy at a very early date; but while this ropiness was very well marked, the mucin was difficult to separate. At a later date, when the ropiness had in a measure disappeared, the mucin was more easily precipitated. This mucin, you will understand, is precipitated by weak acids. He later accounts for this by stating that, as the culture grows older, a gradual production of alkali in the fluid increases the solubility of the mucin, and in this way the liquid is rendered less slimy.

It has been my hope to point out in some definite manner the part which mucin plays in the destructive changes known as dental caries, but further investigation is needed to show in the complicated bacterial life of the oral cavity how important a factor mucin production is.

CONCLUSIONS.

To sum up, it may be said that mucin may be produced in the mouth by a variety of bacteria; just how large a number have this property is not yet known.

A mucin-laden saliva is favorable to the multiplication of bacteria, as is also an alkaline reaction.

Prolonged mastication tends to free the mouth from mucin, and stimulates the glands to healthy action. Acid-producing bacteria have, in some instances, the power of producing mucin, when not engaged in the production of lactic acid; but the medium favorable for the production of acid is unfavorable to the production of mucin.

Enzymes are undoubtedly produced by the action of the bacteria which produce mucin, but the effect of the enzymes is not yet known.

Discussion.

Dr. E. S. Talbot, Chicago, Ill. I appreciate the first part of the paper which has just been read more than I do the last part. Dr. Miller also will appreciate the fact that scientists who undertake research work are at the disadvantage of not being able to bring before the profession their ideas as a whole in a manner sufficiently lucid to be understood by everyone. Aristotle, four hundred years before Christ, laid down some laws which are only now being accepted and appreciated by humanity. The scientist doing research work now, as Dr. Miller is, will be glad if in the next one or two thousand years his ideas are fully understood.

The dental profession is young—only sixty-four years old. It was a very good thing that the dental specialty started off at a tangent from the medical profession. The practice of dentistry is widely different from the practice of medicine, and this difference makes it necessary that dentists should take up the mechanical side and perfect it. Had dentists been educated with the medical profession it is doubtful if there would be as good operators as there are today. But, like all mechanics, mechanical dentistry has virtually reached its highest development. Very little that is new and substantial occurs along the line of mechanics at the present time. I question if mechanical dentistry will improve in the coming time to the same extent as it has in the last few years. Dentistry has now come to the cross roads, hence the medical side of dentistry must now be developed. As the essayist has said, dentists are taking up the scientific side of dentistry all over the world, and I am sure that further progress must be along medical lines.

The last part of the paper I cannot discuss, because it deals with original work, and I have never undertaken that part of the work.

The Chairman. We will defer further discussion of this subject, as Dr. G. W. Cook, Chicago, Ill., will now read a paper on a related subject, and we can discuss the two papers together, after Dr. Miller has read his summary of the paper by Dr. Römer on "Alveolar Pyorrhea."

Dr. Geo. W. Cook, Chicago, Ill., then read the following paper:

The Effects of Chemical Agents on Bacteria with Relation to the Saliva.

By GEO. W. COOK, D.D.S., Chicago, Ill.

In the study of the effects of chemical agents on bacterial protoplasm there are three phenomena to be considered. First, the effects of various chemical elements upon the chemical composition of living protoplasm as manifested in the modification of metabolic processes; second, the phenomenon of living protoplasm to adapt itself to chemical elements; third, the effect chemical agents display in directing protoplasmic movement (chemiotaxis).

As understood at the present time the phenomenon of cellular activities is but a chemical change taking place in a highly complex and very unstable molecular substance, and in the living state is readily acted upon by four main groups of protoplasmic poisons, which have been classed as follows: The oxidizing agents or poisons; the salt-forming agents or poisons; the substitution poisons, and the catalytic poisons.

By an oxidizing agent we mean an agent containing active oxygen which readily attacks protoplasm when brought in accessible relation to it. The second group, the so-called salt-forming poisons, are those acids or bases that enter into chemical relations with the proteid substance in the protoplasm. A chemical change is largely influenced by the quality of the proteid molecule. A number of observers have noted the fact that acids or bases will not act as readily on such proteids as keratin, fibrin, and chitin, whilst many other proteids react quickly to acids and bases.

The third kind of poisons are classed under "substitution poisons" and are grouped under two heads, the sulfur compounds and the nitrogenous substances. These have been classed by Lowe among the ketons, aldehyds, and amido groups. The majority of these compounds do not act chemically upon albumin in the lifeless state, but they act as a very violent poison on living protoplasm, which indicates that such chemical agents have a very unstable molecular grouping. The majority of the molecules, chemically speaking, are closed chains, and the poisonous effect is usually in proportion to the number of hydrogen atoms in the molecule, and their being so combined as to give up the hydrogen, which unites with the nitrogen in the living protoplasm, so as to substitute hydrogen instead of some other chemical element in the proteid molecule. These facts have been clearly worked out by Locke, Lowe, Binz, and a great many others.

The fourth group of protoplasmic poisons are usually designated as the catalytic poisons. Their action on unicellular organisms is that of anesthesia. They are composed very largely of organic compounds of the fat series, and are usually endowed with but little chemical energy. The complexity and instability of their molecular composition is the basis of their poisonous action, and when CH_3 or C_2H_5 is added, making an alkali, the poisonous effects are increased; and as the atoms in the alkaline media are increased, so are its poisonous effects. This is also true in the methane series and sulfuretted compounds. If chlorin takes the place of hydrogen in the methane molecule, its poisonous effects are considerably increased.

The study of the action of certain chemical elements upon protoplasm, as represented in the unicellular organism, has added considerably to the knowledge of the physical and chemical properties of living protoplasm; and investigation along these lines has demonstrated that all protoplasm is not the same in its general chemical constituents. It further shows that all atoms in the protoplasmic body are not always essential to the life of the protoplasm, thus demonstrating that protoplasm is dissimilar in different organisms. Scientific investigation along these lines has further shown that it is possible to treat a protoplasmic body with a weak solution of a chemical agent and gradually change the composition of the organism so as to render it incapable of being perceptibly injured by a much stronger solution of the same chemical agent than would have been necessary to destroy its vital activity previous to the first treatment. The investigations on protista, by Davenport and others, have led many to the conclusion that the altered chemical constituents of the protoplasmic body will be transmitted in the division of the individual organism, and that the composition of the cellular protoplasm of the race is largely in accordance with the media in which the previous generation had lived.

In the consideration of what reagents act upon the elementary vital functions of protoplasm, there are a number of things to be taken into consideration; for instance, the supply of oxygen—for it is a well-established fact that the vital activity of protoplasm cannot survive for any great length of time in the absence of oxygen. An exception to this is the anaerobic bacteria, some of which are immediately destroyed in the presence of free oxygen. But it must be borne in mind that in the absence of free oxygen they obtain their oxygen from the breaking down of oxygen-containing molecules, and in this way obtain the oxygen necessary to enable them to carry on their nutritive function.

It has been determined that certain forms of the unicellular organisms are detrimentally affected when the oxygen supply is diminished. Clark and Demoor demonstrated that the protoplasm of plasmodia myxomycetes and various tissue cells must have a pressure of oxygen ranging from 1 mm. to 3 mm., and when the quantity was diminished below these points protoplasmic movements were reduced in accordance with the diminished quantity of oxygen. When the organism was held in a 0.1 or normal salt solution for from two to three hours it became inactive, and the cells showed a granular appearance, but when the normal quantity of oxygen was again applied cellular activity was re-established—thus showing that death had not occurred in the cell, but that the organism was capable of re-establishing its cellular activity and carrying on all the functions of life.

The increase of oxygen above the normal quantity accelerates the protoplasmic activity of the cell, which causes it to assume just the opposite action to that which takes place when the amount of oxygen is diminished (Demoor and Rossbach). So it will be readily observed that the poisonous effects of any chemical agent must necessarily be materially influenced by the quantity of oxygen present in the environment in which the organism is living. Not only is the organism detrimentally affected by these chemical poisons, but protoplasmic activity of the organism may be materially increased or decreased in relation to the quantities of certain physiological elements which may be present in its nutritive media.

Ozone (O_3) is extremely destructive to bacteria in water, provided the water be free from organic substances, otherwise it kills bacteria only in proportion to the organic compounds contained in the water and the quantity of ozone that is liberated in the water containing the bacteria. Its effects on dry substances containing bacteria are very feeble.

Hydrogen has very deleterious effects on unicellular organisms; for instance, the amœba, when in the presence of hydrogen for twenty-four hours, became spherical in shape and very inactive. The same was true of the myxomycetes. These cells became granular when exposed to hydrogen for forty minutes, and all cellular movements were completely suspended when the exposure was continued for a longer period. Certain motile bacteria were subjected to the same test, and, while some required more than forty minutes' exposure before becoming motionless, others lost their activity when exposed for only twenty minutes.

After considerable study the following conclusion was reached: that the difference in the time of exposure required to cause these organisms to lose their power of mobility was mainly due to the kind of media in which the organism had previously lived. The experiments with oxygen and hydrogen fully confirmed the ideas held by Boer and others, that protoplasm differs both quantitatively and qualitatively. Since all activities of protoplasm must take place almost entirely in water, the reagents tested were capable of absorption in water.

The bacteria used in the experiments were: Diphtheritic bacillus, typhoid bacillus, glanders bacillus, cholera bacillus, B. mycoides.

All agents acted more energetically when the oxygen pressure was reduced slightly below the normal, except the so-called oxidizing agents, and these acted more efficiently when oxygen pressure was increased; for instance, when oxygen pressure had been carried to the limit of protoplasmic endurance and hydrogen peroxid (H_2O_2) was added, the life of the cell was quickly destroyed. The oxids of carbon CO_2 and CO have dissimilar effects on different bacteria. The presence in solutions of the oxids of carbon compounds have a slight influence on the death of bacteria when used in connection with other agents. If CO_2 or CO be added to other chemical agents, they materially assist in causing immobility and final destruction of the bacterial cell in from twenty to sixty minutes. However, it must be borne in mind that the carbon oxids have far less influence on the physical and chemical constituents of bacterial protoplasm than they do on many of the other forms of unicellular organisms; and that they have a different action on the protoplasm of different bacteria is a fact well demonstrated by Demoor.

The presence of ammonia in solutions influences the mobility of bacterial protoplasm by first increasing and finally diminishing the movements. until the organism is at perfect rest. The immobility does not signify that the life of the protoplasm has been destroyed, but it has only assumed a state of anesthesia. These poisons, as was previously stated, are classed as catalytic. There is, however, a certain compound which is neither acid nor basic, and which possesses but little chemical energy, that influences bacterial movements very much in the same way as do the ammonia compounds. Most prominent among these are chloroform, chloral, methyl alcohol, carbon disulfid, etc. Nagel's theory is that these poisons act upon protoplasm because of the unstable condition of the molecule in the chemical agent and the reactivity of the protoplasmic substance to such agents. It must be borne in mind that these agents act by anesthetizing the protoplasmic movements, and as the quantity of the agent is increased it continues to act until the reactivity of the protoplasm becomes entirely arrested. This has been designated by some as the law of relation between molecular composition and strength of action.

In the methane series the poisonous action is increased by the addition of carbon atoms to the molecule up to a certain point; then the molecular compound becomes more stable, consequently its influence upon protoplasm is comparatively indifferent. However, if the hydrogen atoms in the molecule be replaced with chlorin atoms, the poisonous properties are materially increased.

The action of the various alcoholic compounds on unicellular protoplasm demonstrates that the action is modified by the chemical constituents of the molecule in the alcohol; for instance, methyl alcohol (CH_3OH) has a weak action; the ethyl alcohol (C_2H_5OH) has somewhat increased poisonous effects; while the isopropyl alcohol (C_3H_7OH) is a very active poison. The action of these three agents becomes more detrimental as the carbon compound in the molecular substance is increased.

When many of these agents were confined to the saliva as a solvent medium, the influence on bacteria was changed in their general constituents more than when they were in simple solutions in water. This can be accounted for only in two ways; the difference in the density of the medium and the poisonous effects of the agents themselves. When bacteria are confined to the saliva as an habitual medium, the phenomenon of osmosis plays an important part in the organic constituents of protoplasm.

The quantitative determination of the osmotic pressure of saliva was determined by the method employed by Pfeffer, and it was found that there was a variation in the osmotic pressure of saliva obtained from different sources; and it was found that in saliva, when the tension fell below 6 atmospheric pressure the bacteria changed in their morphological appearance, assuming a form many times smaller than the original cell. When a solution of the above-named alcohols was added, death of the bacteria took place in from one to three hours earlier than the same solution would produce under normal osmotic tension. This was also true of many other solutions that did not contain the alcohols above named, but in their stead chloral hydrate, chloroform, and sulfonal. The same was true when the tension of the saliva was raised above 7 atmospheric pressure. The higher the tension of the saliva the more deleterious were the effects produced by the agents. When the tension of the solution remained from 5½ to 7½ atmospheric pressure, the bacteria had far more ability to with-stand many of the poisonous agents than when the atmospheric pressure was reduced below these points.

The carbon oxids, which are almost constantly present in saliva, seemingly influenced the action of many agents that were tested for their poisonous effects. The tension pressure of osmosis in saliva is materially influenced by the presence or the introduction of free oxygen in the solution. It is also a well-known fact that salts of dissimilar structure have different osmotic pressures even when the molecules in both solutions are the same. This would indicate that potassium, sodium, calcium, etc., have an important influence on the osmotic pressure, as was manifested in various solutions. A 0.5 per cent. solution of the following agents: potassium, sodium, lithium, ammonium, calcium, strontium, barium, magnesium—and especially the chlorids of these compounds—were found to have beneficial influence on the growth of bacteria, but if the quantity of these salts were increased above 1 per cent. certain of the bacteria were both physically and chemically changed, while other forms of bacteria would carry on all the functions of life in apparently a normal way; but when the tension of the solution was changed, or some other chemical agent was introduced into the solution, they became materially affected. This would indicate that the addition of metal ions introduced into a solution increases irritability in the protoplasm of the cell without changing the morphological appearance to any great extent. On the other hand, it was easy to demonstrate that if the quantity of metal ions was diminished below 0.5 per cent. the irritability of the protoplasm was diminished, as was also its power of resistance.

Tests were made to determine the difference, if any, between the action of solutions of the heavy metals on the growth of bacteria in bouillon and in saliva. And in this connection it might be well to state that there is a wide range of variation in the action of the salts of the heavy metals on bacteria when grown in saliva. A solution of these compounds that would affect the same quantity of bacteria growing in bouillon, in a great many instances, would have but little effect on the same organism growing in saliva. There was an indication, however, that the saliva was more easily decomposed; in other words, it seemed to be more unstable in its molecular composition than the bouillon, although there is a great difference in the osmotic pressure of saliva and bouillon.

However, the soluble inorganic compounds in saliva cannot be exclusively taken into account for the changes that sometimes take place in salivary secretion; for it has been found that by preparing a solution containing all the constituents of saliva, as estimated by various authors, there was some difference between the morphological and pathogenic properties of some of the organisms grown in the artificially prepared saliva and that which was obtained from the human individuals. It was also found that certain poisonous agents introduced into both the artificially prepared saliva and the natural saliva differed very materially in their effects upon certain bacteria. This indicated that, in some of its characteristics, an artificially prepared saliva differs from the normal saliva. The saliva, however, obtained from one individual gave a growth of bacteria that answered pretty closely to the artificially prepared solution.

Of course, it must be borne in mind that there are certain soluble organic substances in natural saliva that must necessarily differ somewhat in different individuals. B. pyocyaneus formed pigment in the saliva of eight persons out of ten, yet at no time were we able to produce the characteristic coloring matter of this organism in the saliva of the two remaining persons; but the characteristic pigment was produced in the artificial solution. If asparagin were added to the artificial solution the peculiar pigmentation was produced in great abundance. It was also found that potassium sulfocyanid seemed to play some rôle in the number and pigmentation of bacteria of both the artificially prepared saliva and that obtained from natural sources. This indicates that the cyanogen compounds play some part in the growth found in certain chemical solutions; and that bacteria differ in their reactivity to the agent, this depending upon the micro-organism used. It is important to bear in mind a well-known experimental fact, previously mentioned, that all living protoplasm is influenced in its life-processes by the media in which it has previously lived.

We have called attention to the oxygen pressure as well as that of hydrogen—two chemical elements that play an important part in the physiological function of protoplasm whether it be in the unicellular or in the multicellular organism. But one of the most important features as regards the life and functional activity of bacteria relates to the mineral constituents of the media in which they grow; for it has been recognized by Vaughan and others that these inorganic salts play an important part in the life of the micro-organism, and the change in the tension of the solution may cause plasmolysis of the bacteria, or alter its chemical constituents. We proved in our experiments that a hypotonic or a hypertonic solution leads to a greater or less degree of injury to the bacterial cell—a phenomenon that has for a long time been recognized. Therefore, a colloidal solution like the saliva, having the inorganic salts enumerated in the list here following would be considered isotonic to the cell wall in the case of most bacteria. But it is a demonstrated fact that the mineral constituents of the saliva have a variation of more than two per cent. in different individuals. Most of the salts exist as chlorids—although the phosphates and carbonates of calcium and magnesium are held in solution by the carbonic acid gas of the saliva:

Potassium	457.2
Sodium	95.9
Iron oxid	50.11
Magnesium oxid	1.53
Sulfuric acid (as SO_3)	63.8
Phosphoric acid (as P_2O_5)	188.48
Chlorids	183.52

And in this solution there are to be found the following organic compounds:

Mucus and epithelium	2.13	1.3	2.2
Soluble organic matter	1.42	3.8	1.4
Potassium sulfocyanid	0.10	..	0.04

The above-named substances are apparently constant constituents of the saliva. Other substances which are not normal, but traces of which are occasionally found, are urea, cholesterin, lecithin, and leucin. Traces of uric acid, biliary pigments, and sugar have occasionally been found; carbon dioxid is present in a gaseous state. All of these substances have more or less influence on the vital activity of bacteria, but with all of them we were unable to account for many of the phenomena that characterized the changes in the products of bacteria—such as toxins and acids produced or not as the case might be.

We then took up a course of experiments which we hoped might lead to something more definite as regards the changes taking place in bacteria growing in saliva. The phenomena of pleomorphism, as well as the pathogenic or the acid-producing powers of the organisms, could not always be accounted for, for the solution seemed to have a bacteriolytic action when it was minus many of the products that have a deleterious influence on the growth of bacteria; and when the osmotic pressure of the saliva was at a point where growth of the organism seemed to be about normal, the osmotic pressure was at a point ranging from 5 to 7 osmotic pressure.

The experiments that followed in the line leading to the determination as to whether or not saliva was capable of carrying from the blood bacteriolysins or antitoxic substances lead so far into the subject that it would be quite out of place to attempt to detail the methods adopted, and under what circumstances it is possible for such substances to appear in salivary secretions. Miller and Hugenschmidt are the first to suggest, or even attempt, any explanation along this line.

However, in 1881, Gautier found that the human saliva contained leucomains, which differ very much in their actions according to their time of secretion and the gland from which they were secreted. He at that time found that saliva contained a poisonous or narcotic substance which when injected into birds showed characteristic symptoms which indicated that the saliva contained a poisonous agent that could by certain chemical manipulations be obtained from that solution. We followed this author's experiments and obtained similar results; we also carried it farther, by trying the saliva that had been freed from its normal inorganic salts as well as bacterial organisms, and testing it in solutions containing various bacteria. On a number of these organisms there seemed to be but little appreciable disturbance; however, with such forms of bacteria as the diphtheritic, typhoid, and B. mycoides, in the saliva of three persons out of ten there was found a bacteriolytic substance. For certain micro-organisms grown in saliva that was tested it proved to be isotonic. When saliva that had been freed from its inorganic salts by dialyzation was placed in solutions containing these organisms, in the saliva of the above individuals there was found to be a feeble bacteriolytic action. It must be borne in mind that these bacteriolytic complements did not destroy the bacteria at once, but when they lived for an indefinite time in the saliva containing these bacteriolytic bodies the organisms became distorted, losing their morphological appearance and also their power of producing disease; and if kept long enough in the presence of these solutions the bacilli would assume almost a coccus form and eventually die. When a number of organisms were placed together in the solution, certain forms seemed to succumb to the action of the solution much more quickly than when they were placed under its influence in pure cultures. This would frequently happen, however, if the cultures were mixed in any media, but not so quickly as when in the solution of the saliva of the three individuals mentioned.

It is to be very much regretted that the methods employed in this experimental work could not be mentioned more in detail, but time and space would not permit. This work has led to the conclusion that the various agents that may be present in the saliva as a normal constituent, or those that may exist there as a foreign substance, have great influence on the growth and on the physiological activity of bacteria in general. It is also an evident fact that saliva will influence the pathogenic properties and the acid-producing powers of certain forms of bacteria. It also demonstrated that bacteria have the power of acclimating the organism to its environing conditions, and that this is manifested by the modification of metabolic processes, and by the movement of certain motile forms of bacteria. It also showed that a change in the physiological activity of the human individual would manifest itself in the saliva and its action on bacteria. The hope of obtaining a chemical agent that will act as an antiseptic in the oral cavity is not to be expected with any degree of assurance. All that need be expected is the mechanical removal of the bacteria present by such solutions.

[For discussion of Dr. Cook's paper see opposite page.]

Dr. W. D. Miller of Berlin, Ger., then read a summary of the paper on "Alveolar Pyorrhea," submitted by Dr. OSKAR RÖMER, Strasburg, Ger., as follows:

Alveolar Pyorrhea.

By Dr. OSKAR RÖMER, Strasburg, Ger.

[SUMMARY.]

THE author says that all noxious agents which produce an inflammatory process in the gums may lead in case of continued action to pyorrhea alveolaris as soon as the equilibrium between the vital energy of the cells and the aggressive energy of micro-organisms is disturbed in favor of the latter. Tartar alone cannot produce pyorrhea, etc., except where the vitality of the parts has been diminished. When there is no tartar present, general and local disturbances of nutrition, slight wounds, etc., are sufficient. He states that it is rare in children, as their alveoli contain more blood and have greater reproductive power. The author takes cognizance of the disturbances in circulation resulting from overtaxing the system as a cause, and describes the symptoms and course of the disease. He states that there has been some difference of opinion as to the way in which bony tissue is disintegrated in pyorrhea. Some speak of it as a molecular breaking down, others as caries, and yet others as necrosis, but no one has yet exactly described the changes which take place.

Dr. Römer illustrates his views on this subject by a number of slides. These preparations clearly show, as Dr. Römer points out, that the bone is converted into connective tissue, although anatomists have asserted that a connective-tissue degeneration of bone is not possible.

His idea of the whole course of the disease is, then, first, that the gums are irritated and infection takes place; the tissues then become infiltrated with round cells. At the same time, from the gums the epithelium grows through this granulation tissue, and this, encroaching upon the normal periosteum, brings about its destruction. It acts upon the bone and brings about a connective-tissue degeneration of it.

Dr. Römer treats cases where the tooth is loosened, and the destruction has extended almost to the apex, by extraction. But where the pocket exists only on one side of the tooth he injects a preparation of cocain-suprarenin; he makes a subgingival injection, and burns out the pocket with the Paquelin cautery. He then cleanses the root mechanically, and finally makes an application of lactic acid.

Discussion.

Dr. W. D. MILLER, Berlin, Ger. I would like to comment upon one point that has been mentioned, and that is the degree of acidity produced. That percentage 0.75 is correct, I think, in the case of bacteria cultivated in bouillon, but I have found that bacteria which are cultivated in foodstuffs will sometimes bring about an acidity corresponding to two per cent. of lactic acid. I think you will be surprised, if you will test a cavity where food has been retained for a long time, to see how highly acid it is.

I am inclined to think that the importance of the viscidity of the saliva has been overrated. I have tested a great many cases and have not found on the whole that the viscidity of the saliva has had a very great influence upon the amount of caries present. I have had a number of cases in which the saliva was so viscid that in attempting to pour it from one vessel to another it would go over in a clump, like the white of an egg, and yet the patient was absolutely immune from caries. Also I have seen saliva as thin as water, and yet the teeth were going to destruction.

Dr. W. H. WHITSLAR, Cleveland, Ohio. I should like to ask Dr. Miller what is his opinion of the views advanced by Dr. Römer upon the connective-tissue degeneration of bone in these cases?

Dr. MILLER. I agree perfectly with what he says in this respect. He has sent seven preparations showing the imperceptible gradations of the bone into connective tissue. It is shown so clearly that there can be no doubt in these cases that the bone is destroyed in that way.

Dr. ELGIN MAWHINNEY, Chicago, Ill. I feel that I cannot undertake to discuss Dr. Cook's paper properly, inasmuch as its subject-matter needs very careful study. It is difficult from simply listening to the reading to get the full import of it. There are two or three points, however, that struck me, and I would like to emphasize them.

The first point is that in the mouth we have all kinds of bacteria abounding. Everyone seems to agree that the mouth is a hotbed of every sort of micro-organic life. Dr. Cook has pointed out the reasons why there is a great variation in the activity of these organisms in the mouth; he states the difference is due partly to the chemistry of the saliva and partly to the condition of the cells of the tissue.

Dr. Cook has incidentally pointed out some of the causes of the changes of the chemistry of the cells themselves, and I think the paper is full of excellent matter for thought. I know it to be the product of much thought and study, deserving very earnest consideration.

There is one thing which I have observed in my studies, and that is the rapidity with which micro-organic life will accustom itself to environment. Dr. Cook told us that if you submitted certain bacteria to the bactericidal influences of certain salts, diluted to the point at which they were not bactericidal, the germs would become accustomed to them, and would by and by require a much stronger solution than they would otherwise require for their destruction.

I do not agree with him, however, that the strength of the solution of certain salts determines their bactericidal action. I do not think that can be maintained. I believe there are certain definite percentages of solution in which the bactericidal action will be found to be greatest, due to its electrolytic and osmotic action.

With regard to tissue cell life, we are on the verge of finding out something of the chemistry of protoplasm. What we need is some thorough chemical investigation of the nature of protoplasm and proteid molecules. And that is what we must know before we can know very much in connection with the prevention of certain mouth diseases. Some people think they can put something into a bottle which will be a panacea for all sorts of mouth diseases. But the conditions of the cells will have to be considered in each individual case.

It has been said that the cells in tissue are constantly changing in their nature in conformity with the habits and foodstuffs of the individual. So the problem becomes a very complex one, and all these things must be taken into consideration before we can do much in the way of prevention of these diseases.

Dr. M. L. RHEIN, New York, N. Y. A couple of points which have been brought up today have considerably interested me from a scientific standpoint. The first is the use of the term "saliva" in this discussion. I think it a mistake when, in speaking of the oral secretions, we use the term "saliva."

The subject of chemico-pathological investigation of the oral secretions is in its infancy, and its results promise to be of permanent benefit to us. I have thought that the word "saliva" should not be used when we speak of the secretions of the different glands that go to make it up—those of the parotid, of the submaxillary, and others, such as the excretory matter thrown off by the mucous follicles. We obtain from all these a fluid which is a combination from very different eliminative organs. We know that we are discussing a mixture produced by these, but the results of this research can only be properly obtained when the different fluids are considered separately.

Clinically, I believe that some fluids are at fault in some cases, and others in others, and while as a whole they make up the oral secretions, it would be better to speak of them as the "oral secretions" rather than as saliva.

In regard to the paper of Dr. Hopkins, I should like to comment upon the immunity from caries that is observed where there is a slight acid reaction. In my clinical experience I have paid a great deal of attention to this, and while I have no statistics to offer, my conclusions coincide with what Dr. Hopkins has said. I do not say, therefore, that I agree with him in regard to the mucin preponderance, but I do say that where there is a small amount of acidity we are apt to have immunity from caries at that particular time.

Dr. G. W. COOK, Chicago, Ill. I will not make any extended remarks at this time. There was so much material incorporated in the paper that perhaps some of it is not quite clear to you. All the points in the paper require much explanation.

I was extremely anxious to bring to your notice the fact that saliva free from all these inorganic salts possessed some property that had an influence on the growth of bacteria.

I think I shall follow Dr. Rhein in the matter of calling these fluids the oral secretions rather than saliva. We have a variation in the saliva, both in quantity and quality, and I believe that to be one of the fundamental points to be considered in the saliva—I do not see how we are to get away entirely from the use of the words saliva and salivation, as these secretions are produced by the various salivary glands.

Dr. RHEIN. Not by the mucous follicles.

Dr. COOK. I believe that the bactericidal properties are transmitted in the saliva almost wholly through the mucous secretions, instead of through the salivary glands. I have no doubt that continued investigations will manifest some very important steps in the line of thought that has been brought out by Dr. Hopkins.

All the work described in the paper was done under the supervision or direction of Professor Stewart, of the physiological department of the University of Chicago. His assistant was expected to be here and bring up a discussion that I think would have been much more interesting than the paper.

A summary of the following paper submitted by Zahn.-Dr. HOFFENDAHL, Berlin, Ger., was then read by Dr. M. L. Rhein, secretary:

The Application of the Constant Galvanic Current in the Treatment of Pathological Conditions of the Teeth.

By Zahn.-Dr. KURT HOFFENDAHL, Berlin, Germany.

THE application of the constant galvanic current for the sterilization of infected root-canals is not an entire novelty. Mr. F. Zierler, a dentist of Hamburg, published in 1900 a brief report thereon in the *Zahnärztl. Rundschau.* Dr. Brenner, a dental practitioner of Vienna, claimed priority for the method against Zierler. Brenner, however, in his publication entered into no particulars regarding practical details, for the reason that he laid little stress upon the matter, and because he could not conceive the possibility of the general application of electricity in the therapy of roots. The following is a literal quotation from his paper, *Zahnärztl. Rundschau,* ix, No. 416, p. 6797: "For a method to become of general use it must not be too expensive or troublesome, but should be of universal application, while its results must be absolutely certain."

At that period the method failed to appeal to the profession; even a demonstration by Zierler did not succeed in convincing practitioners of the advantages it was possible to derive from the electric current. The subject was dismissed with a few words; and it lay buried during three years.

Last year I began my studies and experiments upon the application of electricity in dentistry independently of the experiments of Messrs. Zierler and Brenner—and, in fact, for a time without knowledge of their having ever been carried out. I was soon able to convince myself of the antibacterial effect of the constant galvanic current, and arrived at results which greatly exceeded my own expectations as well as those of my associates in our institute.

The tedious and cumbersome method of treating roots heretofore in vogue has been overcome; in from ten to fifteen minutes the electrolytic action of a constant galvanic current of from 1 to 2 milliamperes, itself insensible to the patient, suffices for sterilizing completely root-canals inaccessible to instrumentation; the same treatment also suffices to bring abscesses located in the immediate neighborhood of the apical foramen, and of a size up to ½ cc., to a condition which will eventually lead to an absolute cure. Fistulæ are treated in the same way.

The chemical effects of the electric current upon living tissues consist in its power of inhibiting inflammatory processes, increasing, diminishing, or arresting hemorrhage, dissolving solid neoplasms, aiding absorption, etc.; its vasomotor, trophic, and cataphoric actions also come into play. Of all these properties the electrolytic is of most importance for our purpose. Prof. K. B. Lehmann of Würzburg showed in 1903 that the anode, *i.e.* the positive pole of a constant galvanic battery, if it be made of platinum is capable through electrolysis of depositing chlorin, oxygen, and hydrochloric acid in an alkaline conducting medium, and that these ions with a current strength of 3.5 milliamperes and fifteen minutes' action possess a decided antibacterial effect. The results of such laboratory experiments are readily applicable to dental practice.

I began my experiments upon freshly-extracted putrescent teeth; these with the root-apices were first placed in a bit of ham and subsequently in a glass tube of about the diameter of a tooth, filled with normal salt solution. The free extremity of the bit of meat or of the tube was connected with the negative pole of a constant galvanic battery. A platinum wire was attached to the positive pole; the wire was plunged into the ill-smelling tooth. This arrangement was necessary, as it was desired to liberate chlorin, oxygen, and H_2O_2 in the interior of the tooth. These ions being only freed at the positive pole, while H is liberated at the negative pole, it is obvious that to obtain a result it is indispensable that the anode be placed in the interior of the tooth. The passage of a current of 1.5 milliamperes during a few minutes through the tooth generated a comparatively strong odor of chlorin; the fluid portion in the interior of the tooth was decomposed, accompanied by the production of oxygen, and at the expiration of ten minutes the putrid canal contents had become desiccated and the odor of decomposition entirely disappeared. This experiment was the basis of my further researches.

I made exhaustive studies of currents of the most varied source and strength; I determined that a street current and one from a Leclanché battery are equally to be recommended in practice. Bacteriological researches to be more fully described later showed that the minimum strength of current required for the destruction of bacteria during ten minutes' passage was 0.6 milliampere. Practical experience, on the other hand, demonstrated that a current strength of more than 2 milliamperes may be unpleasant to the patient, especially when remains of vital tissue are still present in the apical region. Accordingly, I usually employ a current of 1.5 milliamperes, and increase it to 2 milliamperes only in the treatment of abscesses other than about the apical foramen, and of pyorrhea alveolaris.

To carry the electrode I first made use of a round rubber holder with a metal-lined funnel attached to its extremity. By this means I sought to unite the platinum wires in a single handle for the simultaneous treatment of all the canals of a multi-rooted tooth. With such an arrangement, however, it could happen that the connection with one or another of the platinum wires might be broken, and the current, notwithstanding that the circuit remained closed by means of the remaining wires, fail to pass into the canal in question without the operator's knowledge of such failure. I therefore constructed an angular electrode-holder with a spring attachment at its extremity to hold the wires so that the current could be directly guided through each individual canal. A platino-iridium wire is best adapted for the electrode of the positive pole, because in virtue of its inflexibility such a wire can be readily carried into the narrow root-canals. Platinum is indispensable because almost all other metals combine with nascent oxygen and thus interfere with the desired effect.

The action of the electrolytic current is by no means limited to the immediate neighborhood of the electrode, *i.e.* anode; the antiseptic action is likewise active in the intrapolar region. Thus electrolysis takes place when the current passes from a conductor into an electrolytic substance or traverses the junction of two different electrolytes, *e.g.* the various tissues; that is, all the phenomena which occur in the immediate neighborhood of the pole also develop at the boundary between the tissues. At the junction of two different electrolytes (conductors or tissues) new poles make their appearance—virtual poles, so called, which act just like the actual metal poles provided the current possess sufficient tension as it traverses the boundary between the tissues.

It is precisely this development of virtual poles that is of most importance in dental therapy; for whereas the current applicable in the organism can hardly be of sufficient strength to penetrate the boundaries of the various tissues in strength adequate to generate electrolytic effects such as we see at the initial points where the poles are introduced, the conditions are much more favorable in the case of the teeth. During the passage of the current through the tooth but little current is lost through radiation; dental tissue is a very poor conductor, and the moist dentinal canals alone disseminate some of the current. These, however, are quickly desiccated from the decomposition which takes place, and sterilized, so that they soon offer no opportunity for radiation; thus the sides of the tooth act like a perfect insulator. That this really takes place, although it has been so largely denied, can be readily proved by the following experiment: If the apical foramen of a freshly-extracted tooth be closed by a non-conductor like gutta-percha, etc., the crown being also surrounded by some insulating substance, and the tooth now brought into a circuit, the current will at first be conducted through the dentinal tubuli, but at the expiration of a few minutes the walls of the tooth act as insulators and do not permit the passage of any current. This shows that the dentinal tubuli become desiccated and sterilized. The tension of the diffused currents is inversely proportional to the aqueous percentage of the tissues traversed. I also observed that in every experiment with test tubes containing salt solution, decomposition of the contained water into H and O taking place, spaces are formed which exercise an influence upon the strength of the current and so also upon its antibacterial action. Conditions in the mouth are much more favorable by reason of the circulation, fresh supplies of fluid being constantly brought into the region affected by the current.

It is now evident that the tissues in the neighborhood of the apical foramen become sterilized through the development of virtual poles; it is equally apparent that the effect is in no wise lessened by the greater or less depth to which the platinum electrodes penetrate the canal, and also that inaccessible canals are susceptible of sterilization as well as those large enough to permit of being probed.

In selecting the source of the current it is important to choose one that is capable of furnishing the greatest electromotive force possible, the resistance of the tissues, especially of the teeth, being at times almost incredibly great. As an example I may mention that if the current be applied to the dry skin by means of metal electrodes of 1 sq. cm. surface, it is opposed by a resistance equalling 100,000 ohms, whereas with large electrodes 5 sq. cm. in extent and covered with saturated flannel, the cutaneous surface being moistened with salt water, the resistance falls to 5000 ohms. A single element yields about one to two volts of electro-motive force. I therefore employed batteries of thirty to forty elements. When a central (street) current is used I select a rheostat permitting the passage of a current from 0 to 80 volts. If the root-canals are moist, or if suppuration be present, the resistance to be overcome is but slight. Dentin and perfectly desiccated pulp-remains, on the other hand, are extremely poor conductors.

But it is not alone the current strength which is of importance in electrolysis, but also the tension—that is, the relation of the current strength to the cross-section of the electrodes; in the case of two currents of equal strength the tension is inversely proportional to the diameter of the electrodes. The tension obviously is greatest at the points where the two electrodes are applied, decreasing thence as the distance increases, for the current upon entering the tissues divides into innumerable branchlets and rejoins the other electrode through those tissues which are the best conductors. The best conductors are the muscles, the nerves and bones the next best, and in the following relative proportions, 1:2:16. The tissues farthest from the electrodes and intervening conducting path receive but little current. Nevertheless, experiments have shown that regions far distant from the electrodes also receive some current. In dental practice it is desired to limit to a narrow region, namely the tooth, the effect of the current, viz, generation of Cl, O, and H_2O_2; to close the circuit it is necessary to have recourse to other parts of the body for the apposition of the two electrodes. For this purpose we employed electrodes of very unequal diameters, a small one to concentrate the current within the tooth and a large one to be applied to a readily accessible part of the body, for example the hand. The large size of the second electrode prevents the occurrence of painful or uncomfortable sensations near the point of application.

The method of sterilizing a putrescent tooth by electrolysis is in brief as follows: After thorough excavation of the putrescent pulp-chamber, all consistent masses are to be removed, if at all possible, from the root-canals with an extractor, and the same gently cleansed to prevent at all hazards any ptomains which may be present from being carried through the electrolytic action of the current into the periosteum. If the root-canals are too narrow for probing, a condition frequently present in such teeth, or if new formation of dentin has occurred, no attention is to be paid to the contents of the canals. We must above all seek to render the canal contents a good conductor; this is accomplished by thorough saturation with normal salt solution. For this purpose I inject a 0.75 per cent. aqueous solution of salt by means of a Pravaz syringe into the canals. All conduction between the pulp-chamber and the gum must be interrupted; this can be effected by carefully drying the sides of the tooth; the application of an insulating layer of gutta-percha—or cement may be necessary if the tooth contains a metal filling or if the gum has perforated into the cavity, etc. For if conduction to the mucous membrane of the mouth occurs, the current applied within the tooth will follow the path of least resistance and we cannot be certain that it has traversed the length of the affected tooth. After thoroughly moistening the root-canal and drying the crown, a platinum wire is introduced into the root-canal as far as possible, taking care not to penetrate the apical foramen.

The wire is to be connected by means of the electrode holder with the positive pole of a constant galvanic battery consisting of about thirty to forty cells, or with the terminus of a central current equivalent to the battery; the negative pole is to be applied to the hand of the same side by means of an indifferent electrode (preferably underlaid with moistened cork). The current is now to be gradually and uniformly introduced and carried to 1.5 milliamperes and be permitted to pass for about five minutes. Slight variations in the strength of the current, due either to desiccation of the tooth or gradual saturation of the previously dry skin of the hand, are not noticed by the patient, being so gradual; they can be readily corrected by a rheostat.

When an electric current traverses several different conductors it divides so that each one receives a portion proportional to its conductivity. It is therefore possible to successfully sterilize simultaneously all the canals of a multi-rooted tooth only on condition that they offer the same resistance. If, for example, the two canals of a tri-rooted molar are accessible to probing and the third is not, it will only be possible to treat simultaneously the two widest. The inaccessible canal will require separate treatment, the two remaining canals being closed if necessary toward the pulp-chamber with gutta-percha.

As the result of a single treatment the tooth is rendered sterile to such a degree that an antiseptic filling may be inserted and left in place from three to eight days without danger. At the second sitting the current is to be carried through the tooth in the same way during five minutes. Devitalized teeth without pathological changes exterior to the apical foramen are practically sterile after the second treatment, and ready for filling. I fill the roots with a paste of Paramon, thymol, and oil of cloves with zinc oxid, which I pack into the canal by means of small pellets of sterile asbestos cotton. This paste is very good, its only drawback being its unpleasant odor. Abscesses about the apical foramen of a maximum diameter of 0.5 sq. cm., and fistulæ, require three to four treatments carried out as above. The more pronounced the suppuration the more powerful also is the electrolytic effect of the current, so that a satisfactory result may always be depended upon provided that the necrosis does not involve an extent of tissue greater than 0.5 cc. It is not absolutely necessary to employ rubber dam, but under all circumstances we must prevent the entrance of saliva while the current is passing—not from fear of infection, but because the current would be carried by it to the oral mucous membrane and thus give pain to the patient.

For the sterilization of pockets within the gum, due for example to pyorrhea alveolaris, a somewhat stouter right-angled platinum wire may be employed. An electrolytic current is to be carried through this into the pocket as before.

In December of last year I had the opportunity of assisting Prof. W. D. Miller of Berlin in certain bacteriological researches undertaken at my request. These researches, in proof of the practical results of electrolysis, showed that if putrid pulp to which pure cultures had been added and through which a constant electrolytic current of 0.6 milliampere as a minimum had been allowed to pass for ten minutes was transferred upon agar, growth did not occur.

Moreover, Professor Warnekros of Berlin and myself tested the germicidal action of the electric current. The results were in the highest degree satisfactory. The decrease in the percentage of germs in experiments with extracted teeth infected with pure cultures, after ten minutes' passage of a constant electric current of 1.5 milliamperes was 97 to 100 per cent., experiments upon patients giving 86 to 100 per cent. For these experiments upon patients such teeth were usually selected as had occasioned pathological changes of the periosteum. The fact that the decrease in the number of germs was not complete is probably due to the circumstance that the bacteria, after the initial action of the electric current, get as it were into a voracious condition, when it is difficult to destroy them. For this reason I divide the treatment into two sittings of five minutes each, with an interval of two to eight days. The bacteria still vital after the first sitting slowly proliferate in the interval between the treatments, and can be more readily destroyed at the second sitting, when the decrease is regularly 100 per cent.

These striking proofs of the antibacterial action of the constant galvanic current influenced me to attempt the treatment of putrescent deciduous pulps in the same manner. In these cases my method is as follows: After thoroughly removing all putrescent masses from the pulp-chamber, and from the root-canals also if possible, I carry the platinum wire of the anode a very short distance into the canal, the cathode being applied as usual to the hand of the corresponding side; the current is then admitted up to a strength of 0.6 to 1.5 milliamperes. Because of the large apical foramina I have always avoided currents of greater strength. The current is allowed to pass from two to three and even five minutes; the pulp-chamber is then closed toward the root-canals with a thin plate of metal or gutta-percha, which is not allowed to enter the canal. The tooth is then filled with gutta-percha or cement. Thus the root-canals are left empty. Even if the periosteum of the root be diseased, I would advise that trial at least be made of the conservative treatment, especially in the case of deciduous teeth, because of the possible subsequent anomalies of position which may occur.

For the source of the current we may employ batteries of different form and construction; a central current is, however, the most convenient. It is indispensable for our purpose that the current be introduced gradually—that every sudden or abrupt increase in strength be rendered impossible; all this is to be regulated by a rheostat. The more gradually and uniformly the flow begins, the higher the strength which can be borne; the stronger the current which can be employed, the more intense is the effect and the fewer the sittings necessary. Properly constructed batteries may not require a rheostat; still it is better to employ one, because more accurate regulation of the strength of the current is possible through it—an indispensable circumstance where electricity is applied to the head. Especially is a rheostat desirable when but few cells can be used by reason of low resistance of the tissues. I have tried both metal and fluid rheostats. For some time past I have been using a central (street) current; not the slighest variation of the current strength has been noted. My connecting apparatus permits the gradual and constant passage of a current of electro-motive strength of from 0 to 80 volts.

Discussion.

Dr. G. W. Cook, Chicago, Ill. The essayist's paper is an important one, and I would have gladly given way for the gentleman so that he might have had an opportunity of presenting this paper earlier in the session, when it would have received discussion by a larger audience, as this new therapeutic agency is of great importance to us.

Some few years ago I attempted to do something in the line of applying electricity. I found that by applying electrodes to the root-canals the life of bacteria was destroyed. Observations of the action of electricity upon tissue life suggest the question whether this agency does not do more damage than it does good. We should always bear in mind that an agency that will destroy bacteria will act more energetically on the higher forms of life. Bacterial cells are so differently constituted from the cells of higher forms of life that if bacteria can be destroyed by an agent, the same agent will destroy the normal cells of higher forms of life more quickly. Therefore, for the purpose of obtaining perfect asepsis we should be careful not to injure the surrounding parts while we are destroying the microbes, which are often very resistant.

Dr. R. E. McReynolds, Chattanooga, Tenn. I want to compliment the essayist in bringing a new thought to us in this use of electricity in the sterilization of putrescent root-canals. We have tried it in the sterilization of abscesses in soft tissue, and the X ray, which is really a form of electricity, has been applied to the destruction of fungous growths.

The points Dr. Cook made are very apt, and can be observed by anyone. It is very easy to destroy the soft tissue, and so leave a splendid ground for the further development of bacteria.

Dr. M. L. RHEIN, New York, N. Y. I am interested in this paper because I wrote on the same subject as long ago as six years, although I am not surprised that the gentlemen have not heard of my contribution. I shall await the full publication of this paper with interest, for I have read only a summary of it, and I realize that the gentleman is working in a line of practice which I have thoroughly well perfected in the past few years. I understand that the sole difference is in the time of the application and in the material of the anode. I have come to adopt an anode of chemically pure zinc, thereby forcing nascent zinc oxychlorid into the space.

As to the time, my applications have never extended beyond seven minutes. I have graded them for from three to seven minutes, with from one to ten milliamperes of current.

I believe the profession has in this an excellent method of treating septic canals and the apical region surrounding the root, provided that osseous pathogenic conditions have not developed—if the stage of necrosis of the pericementum has not been reached. It has therefore been my recommendation to my students, in acute alveolar abscesses without fistulous opening, to use this method of sterilization. It should, however, be remembered that the application is accompanied with a great deal of pain. For from twenty-four to thirty-six hours the patient will suffer considerably, to the extent of simulating the onset of pericementitis. But there is no need for worry, as it will subside. I am convinced that the absolute cure of alveolar abscesses can be secured by one single application of this form of therapy. I wish to emphasize the fact that I have used this means myself in many cases.

Dr. MCREYNOLDS. I did not understand from the summary that the writer uses this method for the purpose of carrying medicinal agents.

Dr. RHEIN. Yes, that is what the paper has stated. The question of the degree of germicidal effect of the electric current and of the agents resulting from the electrolytic action is in my own mind uncertain. But we do get the effect of the combination of the electrical force with nascent agents.

Dr. MCREYNOLDS. As I understood the paper, it referred to the use of electricity alone.

The CHAIRMAN. He does not use it in connection with the drug, but through electrolysis the drug is produced. The chlorin, the hydrochloric acid, and the oxygen are given off, and these act as bactericidal agents.

Dr. RHEIN. That was exactly my own status. The use of an anode of pure zinc is of itself inoperative, but, with the chlorin present, molecules of nascent zinc oxychlorid are set free and forced into the apical region and into the canal.

Dr. N. S. JENKINS, Dresden, Ger. I have had no experience at all with this method of sterilization. I only know the simple methods which are found to be sufficiently efficacious in my own practice. The first thing to do is to relieve the patient of pain; the next thing—and I say it with all due deference to Dr. Rhein—is to keep the patient continually free from suffering; and the third thing is to cure the abscess. I could not hear distinctly all the details of Dr. Rhein's treatment, but I did hear him say that it put the patient to considerable pain. If that be the case, I think it is in this respect bad treatment, because sterilization, cure of abscess, and permanent filling of the root can in almost every instance be accomplished without pain. I heard him say that he used zinc oxychlorid, and I wish I could tell him how glad I am, although I suppose he does not use it in the ordinary and simple way. The result of my experience is that if the apex of the root be filled with zinc oxychlorid, after appropriate preliminary treatment, that abscess is eradicated forever.

Dr. COOK. Dr. Jenkins answered the query I was going to put, namely, in reference to the causing of pain. While he was speaking I was reminded of a little incident. A very eminent surgeon was lecturing for the last time to a class of medical students. He said: "Gentlemen, you will soon leave this institution and it will not be long before the responsibilities of practice come upon you. Probably the first case you will have will be an emergency case. You will have no history of the case or knowledge of the individual, but you are brought at once into a sick-room where a patient is suffering pain. And when that patient is in pain the thing to do is to give him something that will relieve the pain."

Our patients come to us for the relief of pain. We have in this method the liberation of zinc and chlorin, which are very irritating, and I say that neither will destroy bacteria as quickly as they will destroy the cell structure round the tooth. If irritation be set up, I question if the affected tissue will ever return to its original normal condition. Infected material is present, and it is the destruction of this material which should be brought about. If a less radical method can be employed to modify the infected field so that the development of the micro-organisms cannot take place so fast, it will be better. If a patient came to me with such an infected condition, I would prefer to employ less radical methods. I would give the patient relief and then would let the processes of nature do the rest. I believe that nature can often do more than can be done by all the electricity and agents in the world.

Dr. RHEIN. I realize that we should do what is best for our patients, but with all due deference to my esteemed friends, Drs. Jenkins and Cook, I will say that from the very inception of my practice I could never harbor the idea so beautifully portrayed by Dr. Cook. On the contrary, to me it represents exactly what the student should be impressed not to do. When a patient comes to me I am not there to follow his ideas and directions, but, on the contrary, I should follow my ideas of what is best for that patient. And if my ideas interfered with his notions, our lines as patient and physician must separate and part. I am there to use my judgment, and if the patient be not willing to submit to that, we cannot get along. The case cited by Dr. Cook follows the wrong procedure. I believe that sort of treatment by physicians has been the cause of the death of many people, because the diagnosis of disease is materially interfered with when alleviating drugs are used before a diagnosis is made.

With regard to the question of the infliction of pain in this method of curing an acute alveolar abscess—I speak now as far as possible for our distinguished visitor, Dr. Hoffendahl—I did not state that this treatment invariably caused pain. In my own practice I never use this agent until after I have impressed upon the patient the fact that its use is often accompanied by severe pain for twenty-four hours or longer, but that after that period the disturbance is cured. We know it is cured. If you adopt some other method it means treatment for weeks and months, with possibly a recurrence of the trouble. With all due respect to my esteemed friend Dr. Jenkins, I will say that I have not found a patient—and I have had many treated by this method—who has not preferred that one single treatment to the horror of coming to a dentist week in and month out for the treatment of chronic alveolar abscess.

Dr. C. M. Meade, Carmi, Ill. I would like to ask Dr. Rhein if, when he has filled a root-canal in the manner he describes, it ever gives trouble afterward.

Dr. Rhein. I have never known of any, doctor.

Dr. Meade. No soreness or tenderness?

Dr. Rhein. Not after the initial soreness has subsided.

Dr. Meade. I understood you to say that there was soreness in some cases afterward.

Dr. Rhein. Yes, due to the severity of the treatment; the pain lasted for about twenty-four hours.

Dr. Meade. And does nature always take care of it afterward?

Dr. Rhein. Yes, if the case has been well chosen—that is, a case in which there has been no osseous necrosis.

The Chairman. Dr. Hoffendahl is of the opinion that even after necrosis has developed no more sterilization takes place than about one-half a cubic centimeter above the root.

Dr. Rhein. Dr. Hoffendahl clearly gives both the amount of time and the strength of the current which should be applied. These are important items, in my estimation. He states that he is as positive of the cure in the case of osseous infection as in other cases. I have not yet reached that conclusion, although I have had many cases where necrosis of the hard tissues has taken place and this treatment has been pursued. I do not feel justified in presuming that those cases are positively cured; we all know how often we get recurrence in these cases of alveolar abscess.

Dr. W. V-B. Ames, Chicago, Ill. In preparing to discuss a paper in another section on electro-therapeutics my attention was called to an article in the August *Cosmos,* in the department of "Review of Current Literature," in which Dr. Miller is quoted as having stated before the Odontological Society of Great Britain that Dr. Hoffendahl had read a paper on "Electrical Sterilization of Root-Canals." This decided me to mention the matter before the other section. On learning that Dr. Hoffendahl was to read a paper I very much desired to hear it.

In May 1884 I read a paper before the Illinois Dental Society upon the use of the galvanic current for the purpose, and I have followed it up ever since, making the application in various ways.

Dr. Rhein. How did you use it?

Dr. Ames. I have here a copy of that paper from the Illinois Transactions of 1884, in which I said that my attention was attracted by a statement that nascent ozone would sterilize putrid air in the proportion of one part in three million. I was familiar with nascent oxygen by electrical action, and I thought it would be an ideal means of disinfecting the putrid root-canal.

I applied a sponge negative electrode to the cheek or gum surface, and the positive electrode—a delicate platinum or platinized gold wire—in the root-canal, and I would thus decompose the fluid in the pulp-canal. If necessary, I would flood it with a solution of sodium chlorid or acidulated water. Immediate root-filling was the craze then, and I made the statement that in these cases I felt thoroughly safe in filling the root, and that it was the only treatment that I had found which was safe. I can still report that it is the most efficient way of immediately sterilizing root-canals. In the matter of general therapeutics it has been stated to me that the passage of the galvanic current will destroy microbes for a distance from the positive pole, so that an abscess can be aborted by placing that particular point in the direct path of the galvanic current. In my own work I merely counted upon the liberated nascent oxygen and its action in the root-canal.

I think that we should have practiced this method more than we have. Back in those days nobody took enough interest in my statement, on account of the general unfamiliarity with electrical apparatus. I have not used it universally, because its application takes time.

Dr. RHEIN. How much time?

Dr. AMES. A ten or fifteen-minute application—occasionally less. But to do it thoroughly, with a fine point passed from the orifice into the canals gradually, would take fully that much time.

Dr. RHEIN. You do not know how much current you used?

Dr. AMES. I did it at first more or less empirically. Sometimes one Bunsen cell was sufficient. I was using an electric mallet then, and I used sometimes one and sometimes more of those Bunsen cells—I should say three cells at most. But the amperage and the voltage depended upon the resistance of tissue. Now I would use about three milliamperes of current from a series of cells controlled by a rheostat, according to the resistance of the tissue.

I have not used this method regularly, because I have not always wanted to fill the root immediately, and I can put in an efficient germicide in a shorter time and let the patient go. But the electrical is a most efficient process to enable one to at once proceed safely with the filling of a root on which an abscess does not exist.

Dr. RHEIN. You would use it for the cure of alveolar abscess?

Dr. AMES. For the cure of a "blind" abscess I know it would be beneficial, but in such a case I would rather wait, and watch the result of a first treatment.

Dr. RHEIN. Have you ever used this treatment for the cure of alveolar abscess?

Dr. AMES. Yes, I have, and had beneficial results. With the very efficient apparatus we have now it ought to be a most useful and practical process. I used the electrode within the root for "blind" abscesses, and in the fistulous opening in cases which had progressed to that extent. Some present may be familiar with my use of the positive electrode in pyorrhea pockets.

I am very glad that Dr. Hoffendahl has presented the subject in this more thorough and more scientific manner, and trust that with our present greater familiarity with the management of electrical apparatus this process will attract the attention I think it deserves.

Dr. HOFFENDAHL—interpreted by the Chairman (closing the discussion). I have taken particular pains to notice the effect of electricity beyond the apical opening, and I have found that, beyond the apical opening, H_2O_2 is also created in the same way. I have found that the bacterial growths decrease one hundred per cent. within fifteen minutes. After the use of the electrical current for five minutes the bacteria are practically in a state of starvation. I then give the bacteria time enough to revive, because they are then more easily killed than in the first instance. I have resorted to the platinum needle because it more readily produces oxygen. If zinc be used, a zinc oxid is produced which is objectionable. As to pain, it may have been due to the enlargement of the apical foramen with the needle, and the pushing in of the bacterial matter—especially in tortuous canals—but the pain usually subsides.

Dr. HAWLEY. Is it not probable that the most important factor in the death of the bacteria is the over-stimulation by the electric current?

Dr. HOFFENDAHL. The reason is the production of chlorin and oxygen.

There being no further business before the section, the meeting adjourned to meet at two o'clock the following day, August 31, 1904, in the music hall.

SECTION II—Continued.

THIRD DAY—Wednesday, August 31st.

THE section having been called to order, the minutes of the preceding session were read and approved.

The CHAIRMAN. I have to extend my thanks to Dr. Johnson, the chairman of Section VII, and to its members, for the courtesy which they have bestowed upon this section by allowing us to use this hall.

Ladies and gentlemen, it would be under any circumstances an honor to preside over this distinguished body, but that honor is intensified when it is accompanied by the pleasure of hearing a paper by a friend which has received the highest prize and commendation. I have the honor of presenting to you a man who is known wherever dental literature is read—a man whose name and achievements will be indelibly inscribed upon the pages of dental history for all time. I present to you a man who has stamped every phase of scientific dentistry with his vast and comprehensive knowledge. I have the honor of presenting to you Professor W. D. MILLER of Berlin, who will now read his prize essay, "A Study of Certain Questions relating to the Pathology of the Teeth." I am sorry to announce that he has met with a painful accident, and it is largely for that reason that he has not been able to attend all the meetings.

Dr. W. D. MILLER, Berlin, Ger., then read the following paper:

A Study of Certain Questions relating to the Pathology of the Teeth.

By W. D. MILLER, M.D., D.D.S., Ph.D., Sc.D.

[AWARDED THE GOLD MEDAL BY COMMITTEE ON PRIZE ESSAYS.]

IT is a fact accepted by the great majority of dental scientists and practitioners throughout the world that the chemico-parasitic theory of dental caries presents a fairly satisfactory explanation of the phenomena exhibited by this disease. Generally speaking, we recognize two stages in the destruction of a tooth by caries: first, decalcification of the hard tissue or tissues of the tooth; second, the dissolution of the decalcified organic matrix. The decalcification is brought about by the action of acids produced in the mouth chiefly by the fermentation of carbohydrates; the dissolution of the organic matrix is a result of the digestive action of ferments of the nature of trypsin produced by bacteria. In the case of the enamel the decalcification is equivalent to total destruction, and the second stage is practically wanting.

There are, however, certain phenomena relative to the occurrence of caries in different mouths which, though of the greatest interest from a scientific as well as from a practical point of view, have not yet found a solution which meets with general approval.

Foremost among these phenomena stands the well-known fact that of two individuals living under the same conditions the one may be absolutely free from caries while the other has scarcely a tooth in his mouth which does not show the ravages of this disease.

Formerly it was assumed that the cause of the marked difference in the susceptibility of different teeth to caries was to be sought for in the teeth themselves, and hard, well-calcified teeth were supposed to suffer little from caries in comparison with soft, poorly calcified ones. More recently some writers, basing their belief on the chemical investigations of Black and others, which show that so-called hard teeth contain but very little more calcium salts than soft teeth, have questioned the truth of the above supposition, and claim that the cause is not to be sought for in the teeth but in their surroundings. Others, finally, lay great stress upon the diathetic factor, although, if it could be definitely established that certain diatheses are accompanied by a high degree of dental caries, this would not affect the problem as to the ultimate cause. It is evident that caries of the teeth must be the result of two groups of forces acting upon each other, and that the one group is to be sought for in the teeth themselves, the other in the surroundings of the teeth. A diathetic condition comes into consideration as a cause of caries in as far as it modifies one or both of those two groups of factors.

Under the first group, the chief and practically only factor to be considered is the resistance which the tissues of the tooth offer to the destructive action of acids. A second, minor factor is the resistance that the decalcified dentin offers to the digestive power of bacterial ferments.

Under the second group the quantity as well as the physical and chemical character of the saliva, its possible bactericidal action, the nature of the food, the shape of the teeth and their relative positions, the nature and number of bacteria in the mouth, etc., must receive consideration.

It seemed to me that the only way which offered any hope of a possible ultimate solution of the question would be to take up each factor in succession and determine its influence as a possible direct or indirect agent in the causation of dental caries. This is the plan adopted in the experiments which I have carried out during the last five years; and although I have not succeeded in concluding the work at the present time, I feel justified in risking the statement that the foundation has been laid and a plan of work inaugurated which must finally lead to a definite solution of this very intricate problem.

We begin, then, with the causes lying outside of the teeth.

(1) THE QUANTITY OF THE SALIVA.

A strong flow of the saliva tends, except in deep cavities where it scarcely penetrates, to dilute the acids produced by fermentation in the mouth, also to wash away small particles of food and to prevent their adhering to the surfaces of the teeth. Its action is of course limited to surfaces with which it comes directly in contact, and in deep cavities full of food it will be very slight. During sleep it practically ceases altogether. I have repeatedly found a cessation or marked diminution in the secretion of saliva as expressed in constant dryness of the mouth, difficulty in swallowing, etc., to be accompanied by acute caries attacking nearly all of the teeth simultaneously and often extending upon the free surfaces. Particles of food remain sticking to the teeth and the acid secreted acts in full strength upon them. (See under (4), page 243.)

The amount of saliva which flows from the glands during a dental operation must not be taken as a necessary index of the amount normally secreted.

(2) THE VISCIDITY OF THE SALIVA.

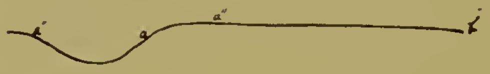
Saliva containing much mucus—stringy, sticky saliva—is conducible to caries in as far as the stickiness interferes with the self-cleansing process in the mouth. Bacteria appear to proliferate also slightly better in saliva containing much mucus. The importance of this factor has, however, been overrated by some authors. I have met with a number of persons free from caries who had extremely viscid saliva, and on the other hand have seen many cases of total destruction of the teeth associated with very thin saliva. Observations extending over a very large number of cases, in 170 of which the character of the saliva was carefully noted, have confirmed this view. The view recently promulgated by Lohmann, that caries of the teeth *is due solely to the action of the mucin of the saliva,* stands at variance with some of the simplest facts of dental pathology and bacteriology to such an extent that it hardly seems indicated to enter into a discussion of it here.

(3) THE REACTION OF THE SALIVA.

A great diversity of opinion exists as to the effect of an alkaline or acid reaction of the saliva upon the course of dental caries. In view of the fact that acids even in a very dilute condition act upon calcified tissues such as bone and dentin, most dentists look upon an acid reaction of the saliva as particularly injurious to the teeth, and as accelerating the progress of caries. Others take the view that an alkaline reaction of the saliva is more likely to be accompanied by caries of the teeth than an acid one. They base this view on the fact that bacteria grow better in alkaline than in acid solutions, and must accordingly develop in greater numbers and bring about a more intense fermentation in alkaline than in acid saliva. The advocates of this view overlook the fact, however, that the reaction must in all cases become acid before caries can set in, and that accordingly the bacteria which cause the first stage of caries must all operate in an acid medium.

The problem is in one respect very much like that of two men running a race over a course such as mapped out in the accompanying diagram *A*, the goal being at *b*, the starting-point at *a* or *a'*. The first runner takes up his position on the ascending slope at *a*, the other in order to get a good start takes his position at *a'*. He starts off more rapidly than his opponent, but forgets that he will have to take the whole of the upward slope, and that by the time that he has reached *a*, his opponent will be well ahead at *a''*, and if they are pretty evenly matched he will have difficulty in overtaking him. So, too, bacteria which begin the race in an alkaline medium start out just so much behind those which begin in an acid medium.

A



A factor, however, comes into action in the case of fermentation by bacteria which is not present in the problem of the runners and which tends to bring about a different result. To adapt this case to the problem of acid production by bacteria, let us suppose that two companies of bacteria, A in an alkaline and B in an acid solution, enter upon a contest as to which can bring about the stronger acid reaction in a given time. Company B is at an advantage in having a certain amount of acid already on hand, while company A must first produce enough acid to neutralize the alkali present before it can begin to accumulate at all. On the other hand, the bacteria in company A have the advantage in that, being in a more favorable medium, they proliferate much more rapidly, and in the course of an hour or two they may have twice as many bacteria at work as their opponents in company B, which would enable them finally to manufacture more acid than they. This development of the question may be made clear by the following experiments.

The mouth was thoroughly rinsed with water and the rinsings allowed to stand for five minutes in a test tube till all the coarser particles had settled to the bottom. 1 cc. of the water was then drawn off and added to 99 cc. of beef-extract-peptone bouillon containing 3 per cent. of sugar.

This was then divided into two portions, A and B, of 50 cc. each, and to A 2 cc. of a 10 per cent. solution of sodium bicarbonate, to B 3 cc. of a five per cent. solution of lactic acid was added. The portion A was thereby made distinctly alkaline and B correspondingly acid. Each portion was now distributed in ten test tubes containing 5 cc. each and placed in the incubator. The *relative** numbers of bacteria present in the two sets of tubes at different periods may be seen in the following table:

	Alkaline tubes.	Acid tubes.
At beginning	76	76
After 1½ hours...........	169	83
" 4 "	875	250
" 6½ "	1125	475
" 23 "	2800	856
" 30 "	150	72
" 48 "	750	800
" 72 "	950	740

A much more rapid increase of bacteria took place in the alkaline than in the acid tubes up to twenty-three hours, after which the number fell off suddenly, to increase for a second time later on. It was likewise observed that the acid accumulated very rapidly in the first few hours, then came a period where very little acid was produced, which was followed by a period of renewed activity.

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* To obtain the actual number, multiply by 400,000.

In a second experiment 50 cc. of saliva with finely chewed potato and a small amount of bread was divided into two equal portions of 25 cc. each. To the first portion I added 1 cc. of a 10 per cent. solution of sodium bicarbonate, to the other 1 cc. of a 5 per cent. solution of lactic acid. The two portions were then distributed each in 5 tubes of 5 cc. each and put in the incubator. The relative number of bacteria in the tubes at the intervals indicated were as follows:

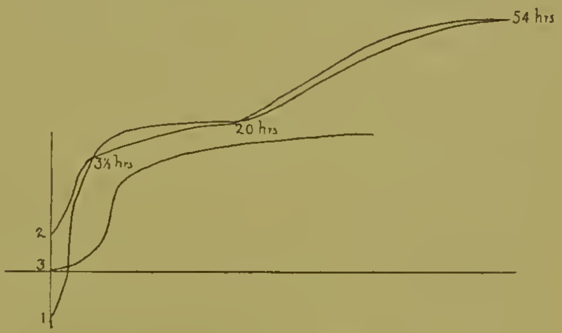
	Alkaline tubes.	Acid tubes.
At beginning	112	112
After 2½ hours..........	650	236
" 6½ "	1775	600

Here, again, we notice the comparatively rapid increase of the number of bacteria and the stormy character of the fermentation in the alkaline tubes in the first few hours. (See curve in diagram *B*.) In 1½ hours the mixture in the alkaline tubes had become neutral; in 3½ hours the degree of acidity was the same in both tubes, a tube of either set requiring 11 drops of a five per cent. solution of sodium bicarbonate to neutralize it.

The further progress of the fermentation is indicated by the curves 1 and 2 in diagram *B* in comparison with the fermentation of a 2 per cent. solution of grape sugar in bouillon (curve 3). Again we see a period of comparative rest followed by a slight increase in activity.

The conclusion forces itself upon us here that the fermentation may be inaugurated by one group of bacteria which later on suffers from the action of its own products and is gradually replaced by another group more resistant to acids. This conclusion is supported by the results of experiments published in the second German edition of "Micro-organisms of the Human Mouth," in which a mixture of foodstuffs with saliva was allowed to stand for four days. The analysis gave—Free lactic acid 0.104, free acetic acid 0.156, combined acetic acid 0.139. It appears that lactic acid may be first formed and later acetic. This very interesting and important problem I hope to solve definitely through experiments now in progress.

B



1. Acid production in alkaline tubes.
2. " " " acid tubes.
3. " " " neutral 2 p. c. sol. grape sugar.

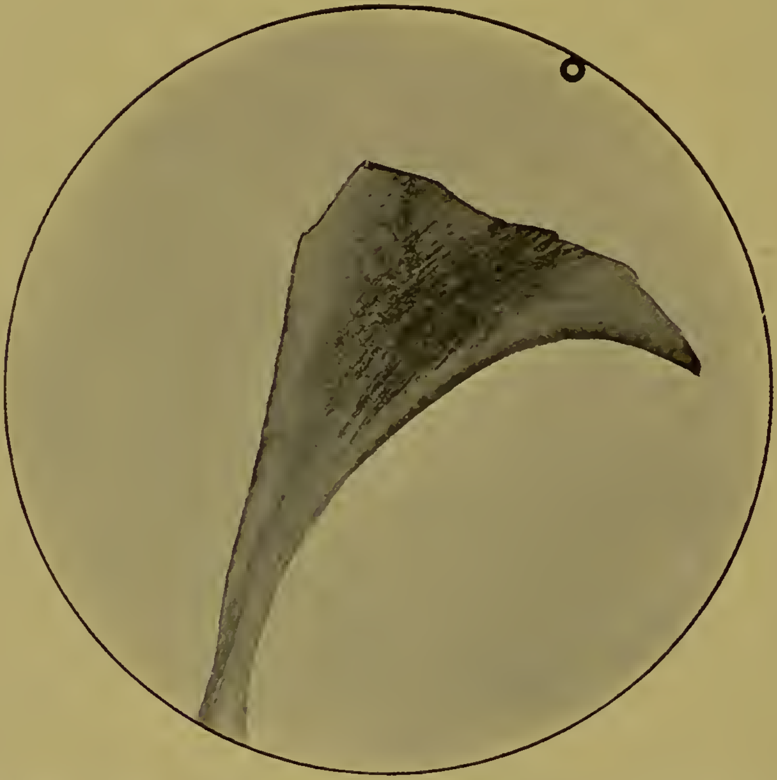
In a third experiment I started out with alkaline material only, adding 4 cc. of a 10 per cent. solution to 96 cc. of potato in saliva chewed up so as to form a fine emulsion. The results were as follows. The alkaline reaction at beginning is indicated by the minus sign:

	Acid units in 5 cc.	Bacteria.
At beginning	–6½	125
After ½ hour............	–6	
" 1¼ hours............	–3	235
" 1¾ "	0	
" 2¼ "	3	1550
" 3¼ "	8	
" 4 "	10	3000
" 5 "	12	5000
" 6 "	13	3000
" 7 "	13	1300
" 8 "	15	650
" 23 "	20	185
" 29 "	22	55
" 32 "	25	90
" 52 "	30	29
" 78 "	33	750

We note here again the very rapid increase in the acidity in the first few hours; a marked second stage in the acid production is wanting. *These results if confirmed by the further experiments which I have mapped out will teach us that when foodstuffs which are impregnated with alkaline saliva lodge between the teeth or in cavities of decay a more rapid development of bacteria will take place in them than when the reaction of the saliva is acid, the result being that the alkali is soon neutralized and a degree of acidity brought about equal to or slightly in excess of that produced where the saliva had an initial acid reaction.* The excess is, however, inconsiderable and its action is offset by the fact that it set in later, and also by the fact that it is constantly being to a certain extent counteracted by the afflux of alkaline saliva. This latter factor will, however, come into account only during the daytime and in superficial cavities; during the night and in deep cavities it will have but slight influence.

Taking all things into consideration, we are forced to the conclusion that the chances for the production of caries are about as favorable in a mouth with alkaline as in one with acid saliva. This result agrees with the evidence which I have obtained from statistics, and also accounts for the fact that opinions among practitioners are divided as to whether an alkaline or acid reaction of the saliva is more favorable to caries. This result is of course valid only under normal con-

FIG. 1.



Dentin from a case of caries acutissima, showing but slight invasion of bacteria and slight histological changes.

ditions, where the reaction whether acid or alkaline is never intense. We occasionally meet with a case where the acid reaction of the oral secretions is pathological and so intense that its deleterious influence upon the teeth is very marked.

A case of this kind came under my treatment only yesterday (June 27th), in which not only do all of the upper teeth of a boy of ten years show extensive approximal caries, but the free facial surface of the smooth enamel is perfectly white and decalcified to a depth of $\frac{1}{4}$ to $\frac{3}{4}$ mm. On the upper left bicuspid the whole of the external enamel wall has been eaten away and the dentin stands completely uncovered, being also decalcified to a considerable depth. The decalcification is here of such a nature and so located as to preclude the possibility of its being produced by fermentation of food alone. The secretions of this boy's mouth are very slight in quantity and intensely acid.

A piece of softened dentin was peeled out of one of the cavities and sections made with the freezing microtome. One of these, stained by the Gram method, is reproduced in Fig. 1. It shows the comparatively small degree of penetration by bacteria characteristic of acute caries produced under a strong acid condition.

On the other hand, a strong alkaline saliva will exert a protective influence upon all exposed surfaces of the teeth, and upon such as have only shallow retaining points or spaces for food.

Preiswerk argues for the existence of an alkaline caries on the ground that acids acting upon enamel always bring out the striation of the enamel prisms, while this striation is sometimes wanting in caries. I have, however, many slides of teeth decalcified in acid media in which the striation is not present. (Figs. 2 and 3.) The absence of striation does not therefore disprove the agency of acids.

(4) THE INTENSITY OF FERMENTATION IN MIXTURES OF FOODSTUFFS WITH SALIVA.

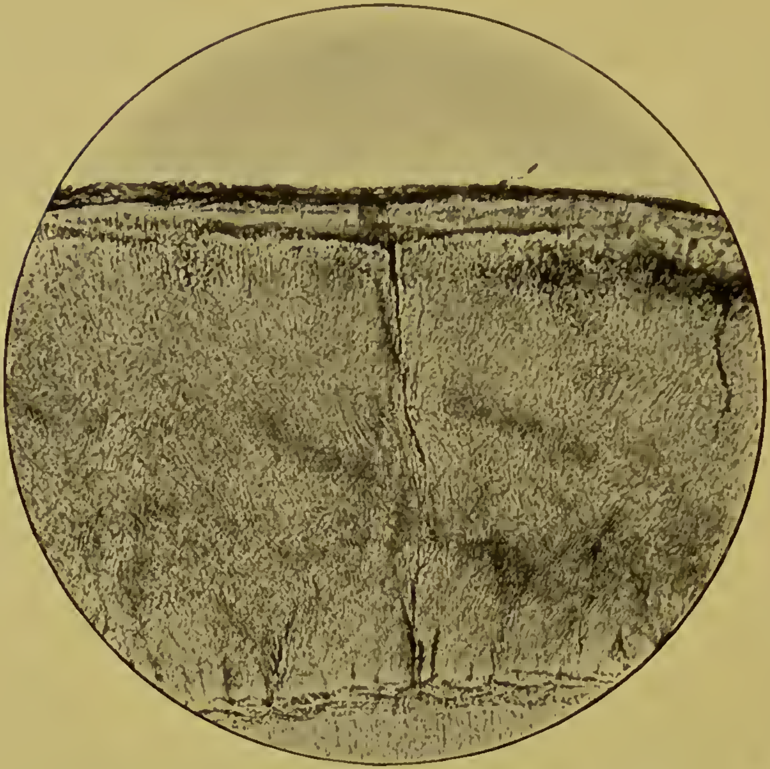
In "Micro-organisms of the Human Mouth" (page 110), 0.75 per cent. is given as the maximum of lactic acid which develops in *solutions* of carbohydrates, and this proportion has been confirmed by other observers. Recent experiments have shown me, however, that in mixtures of saliva with foodstuffs, particularly bread, a much more active fermentation takes place and a greater degree of acidity is produced than in simple solutions of carbohydrates in bouillon or saliva.

This is definitely proved by the following experiment: 5 cc. of a mixture of bread with saliva made by reducing the bread to a fine state of division in the mouth, the same amount of a 2 per cent. solution of grape sugar, and also of a 0.2 per cent. solution of glycogen in saliva were placed in the incubator in similar glass vessels.

In one hour the bread-saliva mixture showed decided acid reaction. The same degree of acidity did not appear in the solution of grape sugar till after four hours. The glycogen solution developed only a trace of acid and subsequently its reaction became alkaline. In four hours the reaction of the bread tube was intensely acid.

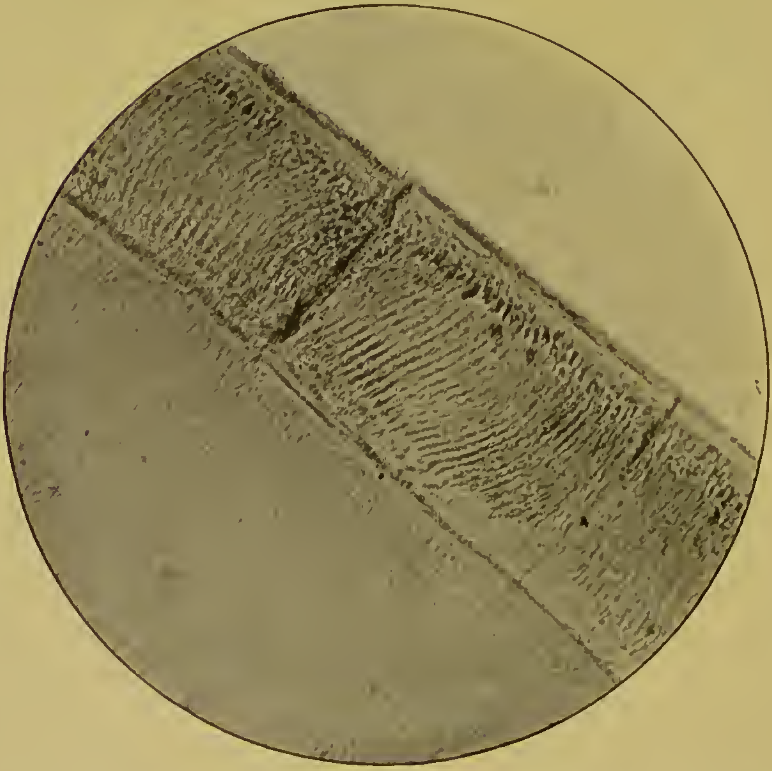
Sections of dentin in the same showed beginning decalcification in five hours, in the grape sugar tube in twenty-four hours. At the same time the contents of the glycogen tube had an offensive smell and had taken on a slight *alkaline* reaction.

Fig. 2.



Superficial decalcification of enamel without striation.

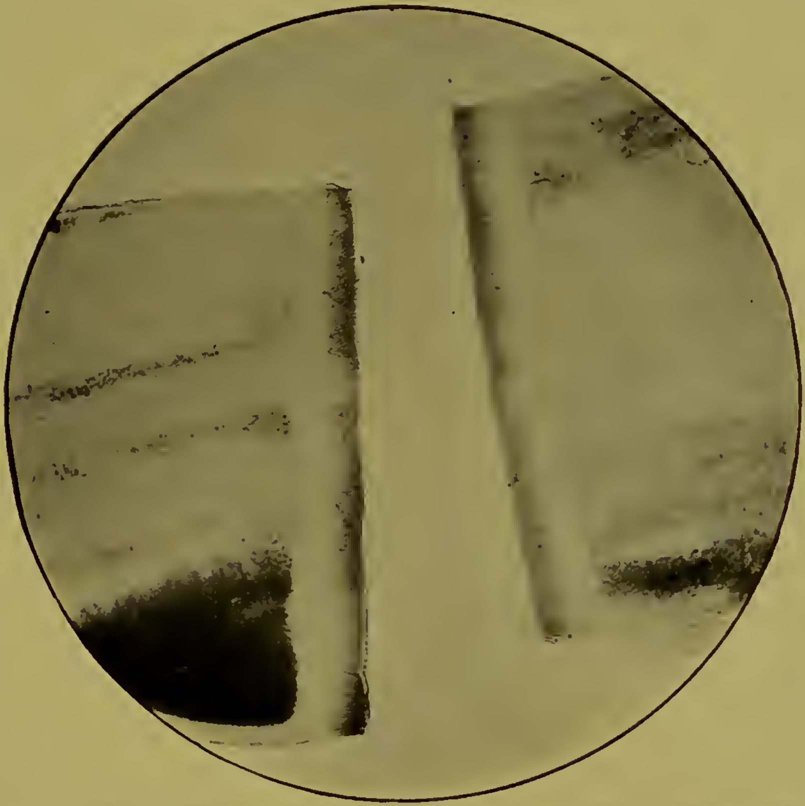
Fig. 3.



Total permeation of enamel by acid without increase of striation.

In another experiment three test tubes received each 5 cc. of a mixture of bread and saliva, finely triturated in the mouth. To one I added 2 per cent. of grape sugar, to the second 0.5 per cent. of glycogen; the third tube received no further ingredient. The three were placed in the incubator and the development of the fermentation watched. It was found that the addition of grape sugar or glycogen did not in the least influence the intensity of the fermentation or the amount of acid formed in twenty-four hours.

FIG. 4.



Pieces of dentin exposed for two days on one surface to the action of a 1 per cent. solution of lactic acid; in the right piece the solution being supersaturated with calcium phosphate. Very slight difference in the degree of decalcification.

I have occasionally found a quantity of acid having a neutralizing power for sodium bicarbonate equivalent to a 2 per cent. solution of lactic acid to be produced in a mixture of saliva and bread in three days.

We may conclude from these results that the intensity and rapidity of fermentation in foodstuffs retained in the mouth is very great, and practically independent of small amounts of soluble carbohydrates which may be present in the saliva.

(5) THE ANTACID ACTION OF THE CALCIUM SALTS CONTAINED IN THE SALIVA.

In the *Independent Practitioner* for 1886 (page 536) I have given some data relating to this question, the discussion of which may here be resumed with profit. Lime salts are often spoken of as antacid and therefore as speedily neutralizing the acids of decay. This is only partly correct. The calcium carbonate is antacid, but the phosphate, which makes up the bulk of calcium salts in the saliva as well as in the teeth and in tartar, is not. Add as much calcium phosphate to a weak solution of lactic acid as it will dissolve, and it will be found to the litmus test to be as strongly acid as before, the lactate and lactophosphate of lime being formed and phosphoric acid set free. The power of the solution to decalcify may be slightly diminished, not destroyed.

Corresponding pieces of dentin were suspended in a 1 per cent. solution of lactic acid and in the same solution saturated with calcium phosphate. I obtained in repeated experiments the astonishing result that no appreciable difference appeared in the amount of decalcification.

The amount of calcium salts carried off by the saliva varies greatly in different persons, as evidenced by the very great difference in the amount of tartar deposited on the teeth.

The anaylses of Frerichs, Jacubowitsch, and Herter place the average amount of inorganic salts in the human saliva at 0.17 per cent., of which but a fraction, say 10 per cent. on a very liberal estimate, consists of calcium salts. Ten times this amount, in the form of 0.075 per cent. phosphate and 0.025 per cent. carbonate of lime, added to a mixture of saliva and bread, did not have the slightest effect upon the course of the fermentation or upon the amount of acid produced.

The antacid action of calcium salts in the saliva as a preventive of caries may accordingly be estimated at zero.

(6) ACTION OF FERMENTABLE CARBOHYDRATES IN SOLUTION IN THE SALIVA AS A CAUSE OF CARIES.

This question I have discussed in the *Dental Cosmos* for 1903 (page 694) with particular reference to glycogen, establishing the fact that fermentable carbohydrates are found in the mouth after each meal in which carbohydrates are taken as food, but that neither glycogen nor any other fermentable carbohydrate occurs in the saliva under normal conditions in sufficient quantity to materially influence the origin and process of caries. If the saliva as it flows from the ducts contained enough fermentable carbohydrate to appreciably affect the course of caries by undergoing an acid fermentation in the mouth, then it would be a simple matter to establish its presence experimentally. The person whose saliva is to be examined would need only to rinse his mouth very thoroughly and then eject some 5 to 10 cc. of saliva, which should be filtered and placed in the incubator. If glycogen be present in any quantity which could affect the course of dental caries the saliva will show an acid reaction in a few hours.

The results of my experiments forced me to the conclusion stated above, and further experiments more recently carried out in this line have confirmed this conclusion.

Again, if we filter a solution of glycogen it remains opalescent, likewise if we add 0.1 per cent. of glycogen (which is the lowest concentration which shows a trace of acid fermentation) to saliva and filter we get an opalescent filtrate, and if the saliva contained a sufficient amount of glycogen to be susceptible of an acid fermentation it should likewise give a cloudy filtrate. I have found, however, that saliva comes through the filter quite clear in cases of most aggravated caries as well as in cases immune to caries. I have met with but very few exceptions to this rule, and they stood in no relation to the degree of caries. Stale saliva is cloudy even when filtered, because of the large number of bacteria which it contains.

The results of all my investigations seem to fully justify the conclusion drawn above, that no fermentable substance of the group of carbohydrates occurs in the saliva in sufficient amount to materially influence the progress of caries. This result accords with that obtained under (3) and (4).

(7) THE CHARACTER OF FOOD.

There can be no doubt that an excess of carbohydrates of a readily fermentable nature, especially if soft, sticky, and slowly soluble, greatly intensifies the process of fermentation in the mouth and accelerates the course of decay.

The following case, which is by no means an isolated one, very clearly illustrates this point. Master A, thirteen years old, showed caries of all of his upper teeth without exception; in the lower jaw two molars and one bicuspid had been extracted and the remaining bicuspids and molars standing far apart and offering no retaining points for food were free from caries, but the lower incisors and canines were all decayed. The saliva was normal in quality and quantity. This boy, besides never brushing his teeth, lived almost exclusively on carbohydrates, eating no meat whatever for breakfast and supper, and only occasionally (once or twice a week) for dinner.

In view of the fact that races both of men and animals that live solely on meat are free from caries, and in view of the many observations and experiments already published, this point may be considered as established beyond discussion, though it does not always receive the attention which it merits.

The physical properties of foodstuffs also form a quantity not altogether negligible.

Certain foodstuffs as a rule lodge about the teeth; others do not. This may be easily seen by eating a biscuit or a piece of cake and observing how many particles lodge in crevices, while fibrous foodstuffs are not so liable to lodge. (Wallace.)

In general sticky, doughy, and semi-soluble substances will be found to be most injurious to the teeth.

Cooking our food not only renders it more fermentable, but also more sticky and liable to lodge about the teeth. This factor contributes, accordingly, not a little to account for the increased tendency of civilized races to caries of the teeth.

(8) THE ACTION OF FAT ON THE TEETH.

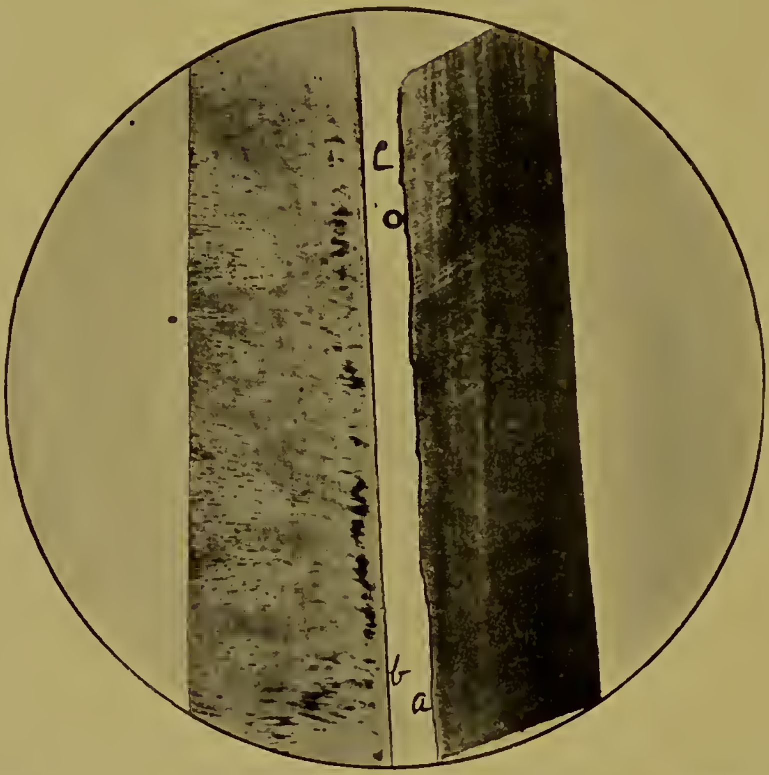
It is known that the enamel of the teeth contains a minute quantity of fat, and Professor Liebreich of the University of Berlin used to maintain that the object of this fat was to protect the tissue against the action of acids. I am not prepared to accept this view myself, but I am convinced that the more or less fatty character of our foodstuffs does have a certain modifying influence upon the course, or at least upon the origin of caries. Pieces of ivory which had been half immersed in turpentine or melted butter and afterward exposed to the action of weak acids were considerably less decalcified on the surface which had received the protecting coat of fat. (Fig. 5.)

This is readily understandable. We likewise know that very loose molars in the mouth without antagonists are usually found to be covered with a greasy deposit, and that they do not decay in this condition.

Undoubtedly a coating of fat on the

surfaces of the teeth such as might be formed on partaking of food rich in fat would tend to protect them against the action of acids; the question, however, arises in this connection whether fat itself may not undergo decomposition in the mouth resulting in the production of acids. This, however, is not probable in view of the fact that fats mixed with saliva and kept at blood temperature give rise to an alkaline and not an acid reaction. This fact makes it all the more probable that fats act to a certain extent as protectors of the teeth.

Fig. 5.



Pieces of ivory protected by a coating of fat at *a*, and of turpentine at *b*. The black lines indicate the degree of decalcification, which is much more pronounced at the unprotected ends, *c*.

J. Sim Wallace ("The Cause and Prevention of Decay in the Teeth") writes: "I have made numerous observations which seem to me to indicate that the relative freedom from caries among people who eat much fat is out of all proportion to what one might expect if one considered fat as neutral in its action on the teeth. Nor do I think that we can account for this freedom from caries in fat-eaters by the fact that these people may eat relatively less carbohydrates."

(9) THE SELF-CLEANSING FACTOR IN IMMUNITY TO DECAY.

Different dentures show very marked differences in regard to the efficiency of cleansing processes, whether spontaneous or artificial. In some the crowns of the teeth are so well formed and arranged and knuckle up together so perfectly that as long as the interdental papillæ are in a healthy condition there is little possibility for food to lodge. In others we find the food sticking between the teeth everywhere. There can be no doubt that this circumstance is of very considerable consequence in regard to the origin and progress of caries. All places where food habitually lodges and can be only imperfectly removed are especially liable to decay. For example, when a bicuspid stands inside of the arch so as to form a triangular space with the neighboring teeth all three teeth are sooner or later doomed to decay. Likewise when the gums recede in old age and the spaces between the teeth easily become packed with food we find extensive caries (senile caries) occurring in dentures which for fifty or sixty years may have been practically immune.

All the cases of immunity to caries which I have examined during the last few months have related to dentures where there was little tendency to retention of food particles.

The comparative immunity of the lower front teeth to caries is due in a great measure to the fact that the food particles do not readily lodge about them, or if they do—as is particularly the case in advanced age when the gums recede and the teeth loosen—then these teeth decay as readily as any others.

(10) THE ANTISEPTIC ACTION OF THE SALIVA.

This question I have treated at length in the *Dental Cosmos* for 1903, page 1. The numerous experiments there reported upon have definitely established the fact that neither the oral fluids as a whole nor their separate constituents (mucus, potassium sulfocyanid, etc.) have the power to prohibit or even perceptibly retard the growth of bacteria.

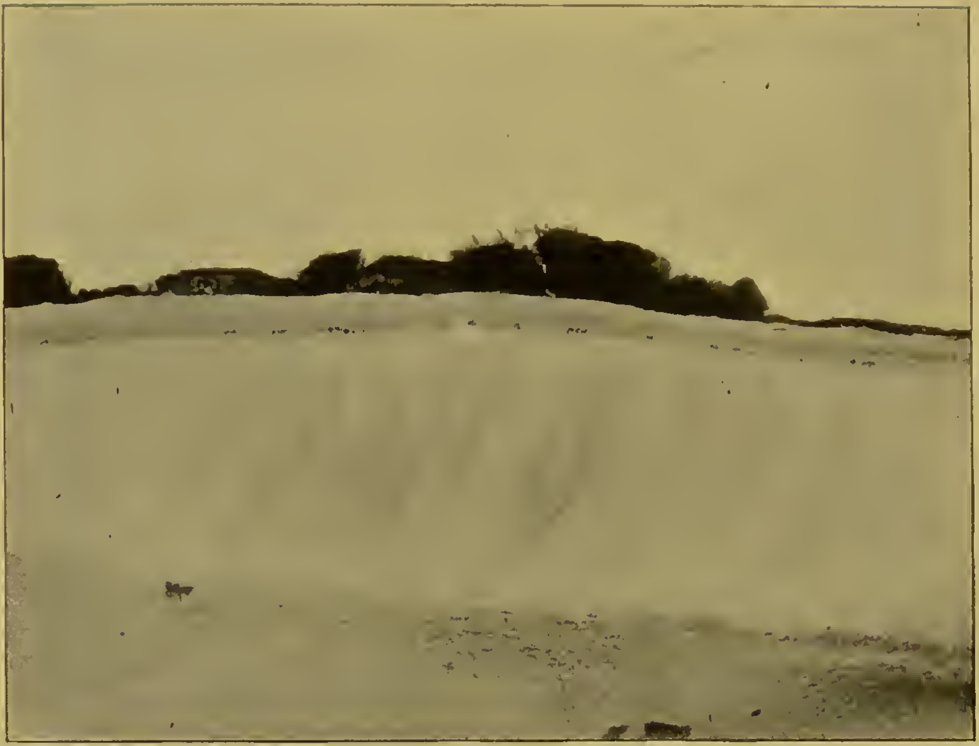
There are neither simple chemical antiseptic compounds present in sufficient concentration to exert a bactericidal action nor have I been able to find the more subtle protective bodies (analogous to the alexins of the blood) in the saliva. In other words, the protective bodies of the normal blood serum (alexins, complements, cytase) do not under normal conditions pass into the saliva in sufficient quantity to be detected by ordinary means.

(11) THE ACTION OF BACTERIAL PLAQUES.

This question has been thoroughly discussed in the *Dental Cosmos* for 1902, page 425, where the conclusion is arrived at that bacterial plaques are essential neither to the beginning nor to the progress of caries, nor does their presence necessarily result in the production of caries. It is possible that they may intensify processes of decomposition in particles of food clinging to the surface of the teeth. Nothing is easier than to find dense films without a trace of caries (Fig. 6), and we may also find caries without films (Fig. 7). In this connection I must refer to my previous publication. Further experiments which have just been concluded tend to confirm the view expressed therein.

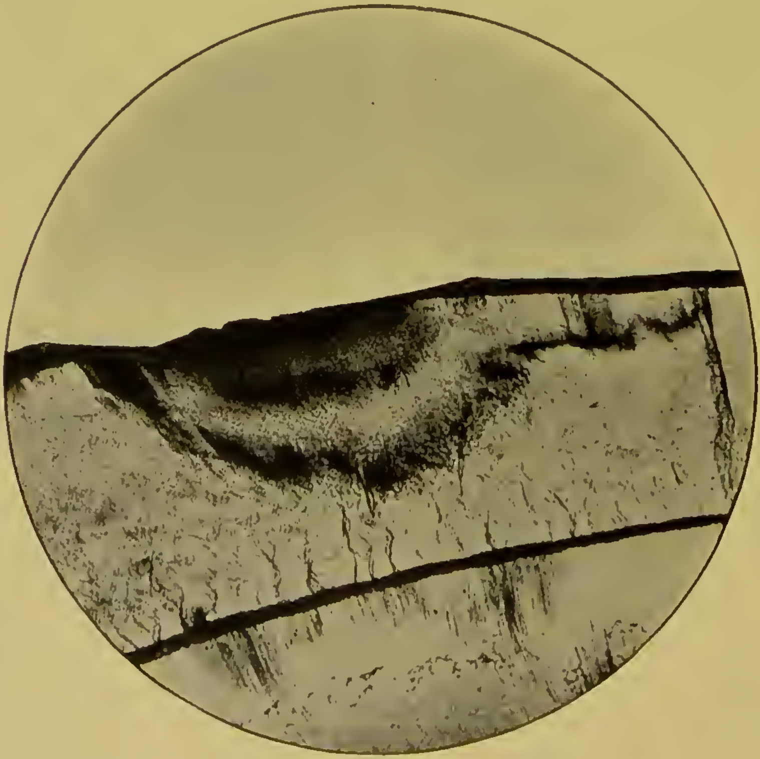
From freshly extracted teeth with sound surfaces the film was removed from a zone about 2 mm. wide, by means of a wood point dipped in tooth-powder. The teeth were then put in a small glass jar, covered with bread or bread and meat finely chewed up, and put in the incubator. The mixture was daily renewed, the teeth being at each time slightly rinsed in pure water. I reasoned that if the film performed any particular rôle in condensing the acid upon the surface of the tooth, then the parts of the tooth from which the film had been removed

FIG. 6.



Extensive bacterial plaque without a trace of caries. (A very common occurrence.)

FIG. 7.



Extensive caries without plaque.

should be less acted upon by the mixture than those still covered with the film. The results did not indicate any such action on the part of the film. On the other hand, in one series of experiments the parts from which the film had been removed were more intensely attacked by the acids than those still covered by it. This result is very clearly shown by the photograph. (Fig. 8.)

In this case the film apparently served as a protection to the tooth. This mixture was, however, allowed to stand during the last four weeks of the experiment without renewal, and it was probable that the bacteria in the film were destroyed by the action of the acid. The experiment was therefore repeated, the mixture being renewed every twenty-four hours throughout the whole time. Here, again, the results show that the surface covered by the film did not suffer any more from the action of the acid than that which was free. In Fig. 9 we have the cusp of a bicuspid which was naturally without film on the buccal surface, *b*, but with a thick plaque on the surface *a*.

This tooth was exposed for four weeks to the food mixture, changed daily, with the result that the free surface, *b*, was decalcified to the same extent as the coated surface, *a*.

We of course cannot be sure that the plaques maintain their normal activity in these food mixtures; it is fair, however, to suppose that they do so for a certain time. Further experiments in this direction are indicated.

I am convinced, however, that when food lodges between two teeth and fermentation sets in, the acid produced thereby will attack the tooth as readily without the agency of a film as with it. The film may, however, have a deleterious influence by favoring the precipitation of fine particles of food upon the surface of the tooth.

(12) THE NUMBER AND KIND OF BACTERIA IN DIFFERENT MOUTHS.

This is one of the most difficult problems with which the dental bacteriologist has to grapple, and a vast number of experiments is necessary in order to enable us to eliminate the various sources of error which are present. One of the most formidable difficulties is to be encountered in the fact that many of the bacteria of the mouth cannot be made to grow as isolated colonies on our artificial culture media. In consequence of this difficulty I have not been able to terminate my work relative to this question, and must reserve my decision for a future occasion.

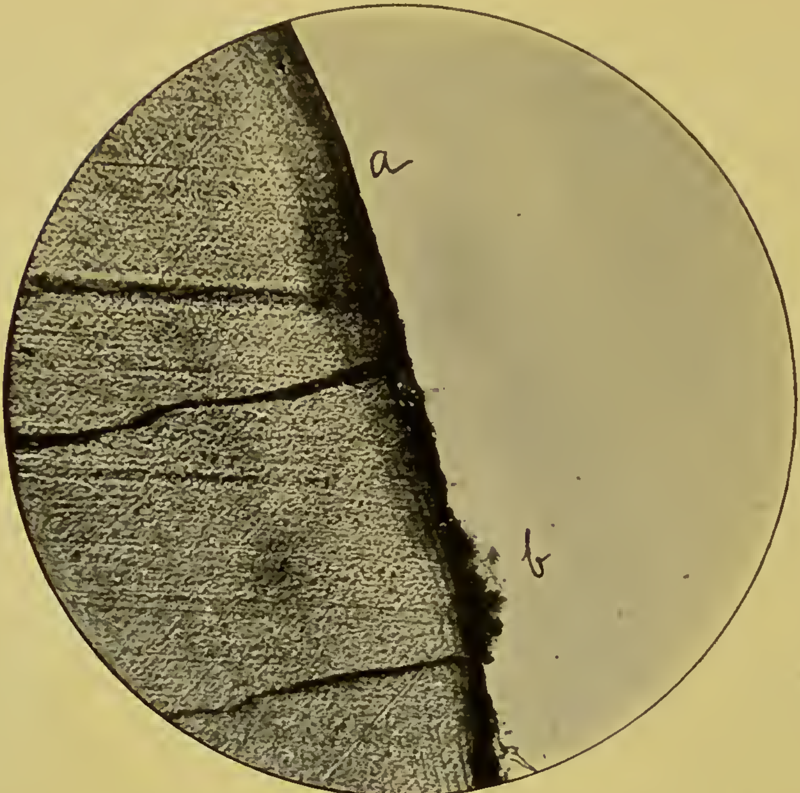
The necessity of a definite answer to this question becomes less imperative in view of the fact that it is virtually included in the following question (13), which is more readily accessible to an experimental solution.

(13) DO PROCESSES OF FERMENTATION GO ON DIFFERENTLY IN DIFFERENT MOUTHS?

Does a particle of food lodged between the teeth of A undergo a different process from that of a like particle between the corresponding teeth of B? It is self-evident that a solution of this question releases us for the present from the necessity of definitely disposing of question (12).

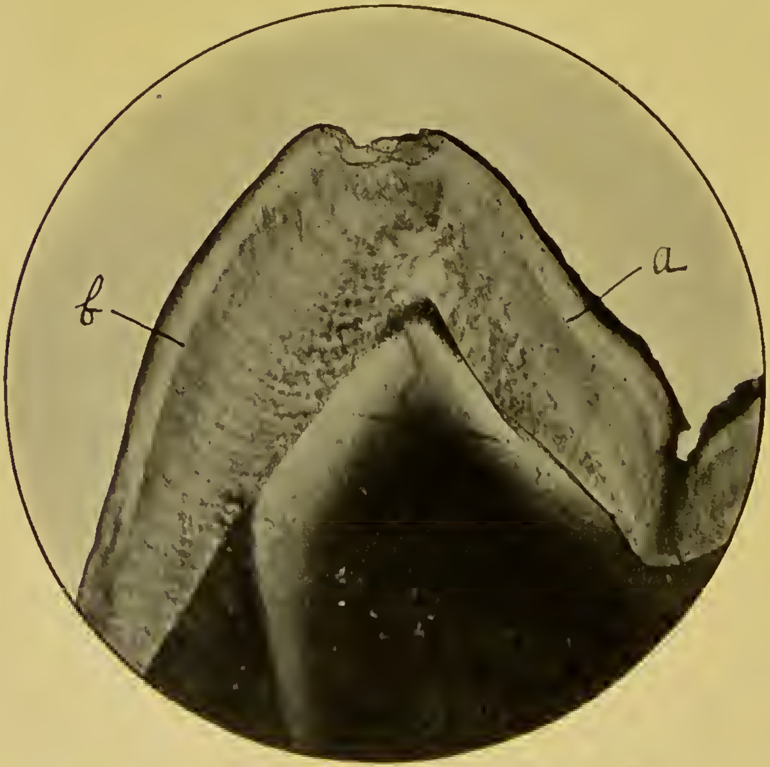
It is not the mere presence of this or that kind of bacterium in certain numbers in the mouth, but rather the joint activity of the total flora of the mouth as expressed in the first instance in the intensity of processes of fermentation in

FIG. 8.



Section of tooth after seven weeks in bread-saliva mixture, the film having been removed at *a*. Apparent protective action of film at *b*.

FIG. 9.



Cusp of bicuspid after exposure for four weeks to food mixture; the filmed surface, *a*, is not more acted upon than the filmless surface, *b*. (The section having been cleared up in xylol, the decalcified layer here appears lighter.)

food particles which determines *ceteris paribus* the extent of caries. I have endeavored to solve this question by an extended series of experiments in and out of the mouth which have been reported upon in the *Dental Cosmos*. The result of all these experiments was embodied in the following conclusion (*Cosmos*, 1903, page 689): "The saliva of immunes develops in the presence of carbohydrates, in and out of the mouth, on an average a little less acid than that of highly susceptible persons. The difference is, however, not constant and is not sufficiently marked to account for the marked differences of susceptibility."

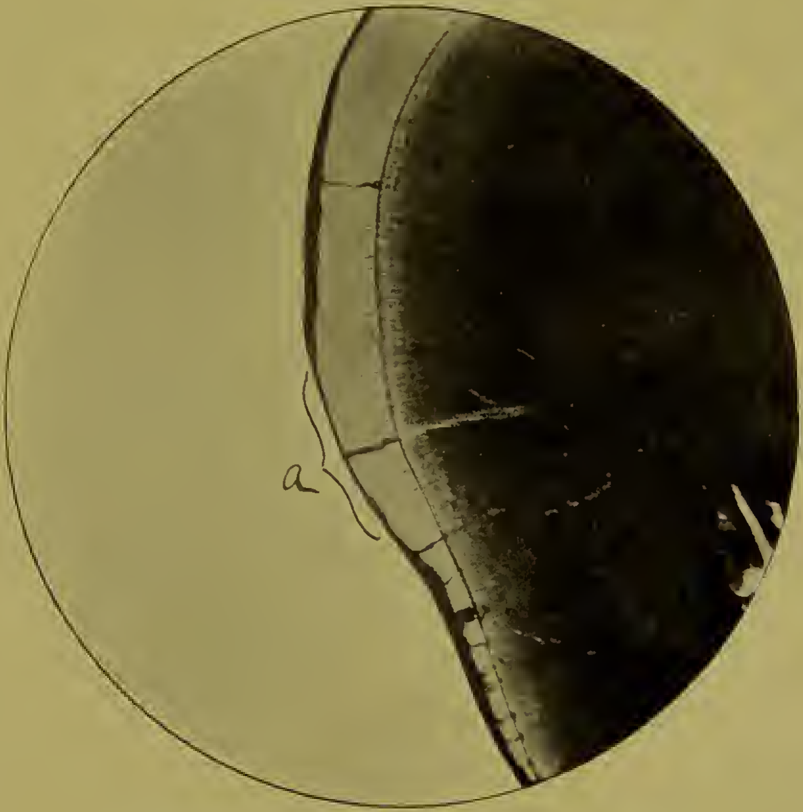
(14) PROTECTIVE ACTION OF DEPOSITS OF TARTAR.

It is a recognized fact that deposits of tartar thoroughly protect the incrusted surface. *Experimenti causa* I suspended a tooth having a nodule of tartar (at *a*, Fig. 10) in solution 4. The surface was completely protected until the tartar was finally dissolved away and the acid then began to act upon the enamel at this point also.

We see from the above that a large number of factors are constantly at work in the mouth some of which directly or indirectly favor the production of caries, some of which tend to counteract this influence, and some of which are practically indifferent in their action on the teeth.

Some of those factors, such as the character of food, are of predominating influence. The use of albuminous substances alone to the total exclusion of carbohydrates or *vice versa* is of itself sufficient to readily account for the fact that

FIG. 10.



Protective action of deposit of tartar (at *a*).

one race (Eskimos) may be immune to caries and another suffer in an extreme degree from it. Likewise a total or nearly total cessation of the salivary secretion is sure to be followed by a marked exaggeration of the tendency to caries.

We may also conceive that of two persons having teeth of the same resisting power and living under the varying conditions presented in modern civilized life, the one in whose case all of the partial factors above referred to tending to the production of caries operate in conjunction may suffer very much, the other in whom they are absent may be practically free from caries. Extremes in which all or even a great majority of the factors predisposing to caries are either present or absent are, however, the exception rather than the rule, and we frequently enough meet with cases for which those external causes alone do not furnish us with an explanation which is quite satisfactory to us, and the question forces itself upon us whether there may not be something in the teeth themselves which furnishes a clue to a solution of the phenomenon under consideration.

It is true that we have been in the habit of speaking of soft teeth and hard teeth, and of looking upon those terms as synonymous with susceptibility and non-susceptibility to caries. An experimental proof of the truth of this belief which puts it beyond the possibility of a doubt has, however, been wanting.

At present opinions are divided between two views diametrically opposed; the one, of which G. V. Black is the chief exponent, finds its expression in the following statement (*Dental Cosmos*, 1895, page 417): "Examinations of the density of the percentage of lime salts and of the strength of the teeth that are certainly reasonably accurate and include a sufficient number upon which to base trustworthy judgment, have shown that neither the density nor the percentage of lime salts nor the strength is in any degree a factor in predisposing the teeth to caries, or in hindering its inception or progress."

I have, however, repeatedly called attention to the fact that it is not solely a question of the percentage of calcium salts in a tooth, but of the stability of the compound formed by those salts with the organic matrix of the tooth.

The rate at which any calcareous body is acted upon by acids does not depend solely upon the percentage of calcium salts which it contains, but upon the stability of the compounds formed by them. A piece of tartar may contain more calcium salts than an equal sized piece of dentin and yet it will be much more readily decalcified than the latter. Unfortunately our knowledge of the nature of the combinations occurring in teeth and bone is very incomplete, nor does it at present appear just how we are to approach this question experimentally. It is quite conceivable theoretically that two teeth may contain exactly the same percentage of calcium salts and still possess different degrees of chemical stability.

The other and opposite view is that held by the majority of dental practitioners, and which claims that teeth of different grades (hard and soft) are liable to be attacked by caries in different degrees. This view has of late years found its chief exponents in Röse and Förberg, who by the aid of statistics have endeavored to show that people who live in districts in which the soil and drinking-water contain much lime have teeth better calcified (harder) and suffer much less from caries than those who live in districts which are poor in lime. In view of those different opinions, both arrived at by most thorough and careful investigations, it seemed to me to be imperatively necessary that the question should be experimentally and finally determined whether the yellow or yellowish (so-called "hard") teeth do or do not offer more resistance to acids than the bluish or gray-blue (so-called "soft") teeth do.

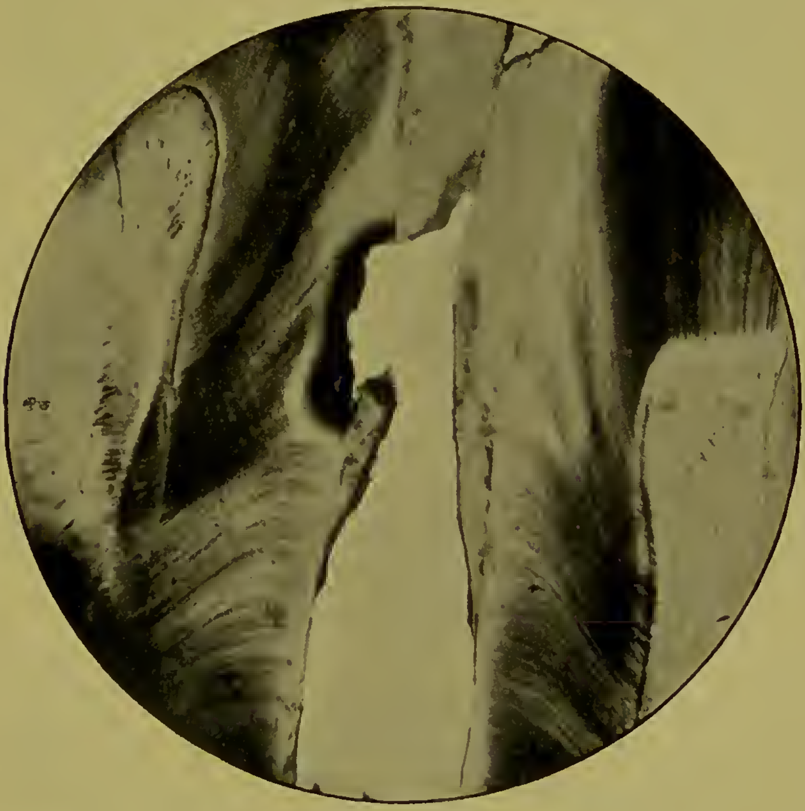
The idea that different teeth offer different resistance to the same destructive forces appears to be supported by the evidences of daily observations in dental practice. We continually meet with cases of two teeth in contact being acted upon to very different degrees. (Fig. 11.)

It is a very common thing to find one of the bicuspids decayed to the pulp while the approximating surface of the other shows only the first beginning of caries. This phenomenon is difficult to account for unless we suppose that the teeth have different resisting powers.

In attempting to solve this question experimentally it seemed wise to me to begin with kinds of dentin which represented extremes in regard to density and amount of calcium salts which they contained. Those extremes were found in ivory and in the dentin of the teeth of the sperm-whale.

The experiments carried out in the manner already described in the *Dental Cosmos* for 1903, page 697, gave the following results:

FIG. 11.



Unequal caries of approximal surfaces in neighboring teeth.

	Specific gravity.	Calcium salts.	Time required for decalcification.
Soft ivory ...	1.76	61.2	65 hours.
Hard " ...	1.84	63.4	96 "
Walrus	1.92	66.8	130 "
Sperm-whale.	2.08	72.7	336 "

We see here a striking difference in the resistance offered by different kinds of dentin to the action of acids—a difference, moreover, which corresponds to the differences in density and amount of calcium salts.

The important question now arises, Do similar differences exist in regard to human dentin from different teeth, and especially from teeth of different classes as regards "hard" and "soft" character?

A great difficulty exists in securing suitable material for those experiments, and in the beginning I made what now seems to me to have been a mistake which caused me a great deal of labor without a corresponding return.

For the purpose of comparison I chose teeth from perfectly sound (immune) dentures and sound teeth from otherwise very imperfect, carious dentures, overlooking the fact that teeth from one and the same denture may show comparatively great differences in structure and composition, and that the isolated teeth which sometimes hold out after all their neighbors have been swept away may have done so simply because of their superior constitution. In my subsequent experiments I accordingly chose teeth of the strong yellow type for comparison with young white or bluish white teeth which were already more or less carious. On the supposition that experiments of this kind, if they are to have any practical value, must be carried out under conditions as similar as possible to those existing in the mouth, I discarded the use of strong acids altogether, subjecting the teeth to such acids and in such strength as are produced by the fermentation of various mixtures of saliva with foodstuffs.

Solutions and Mixtures.

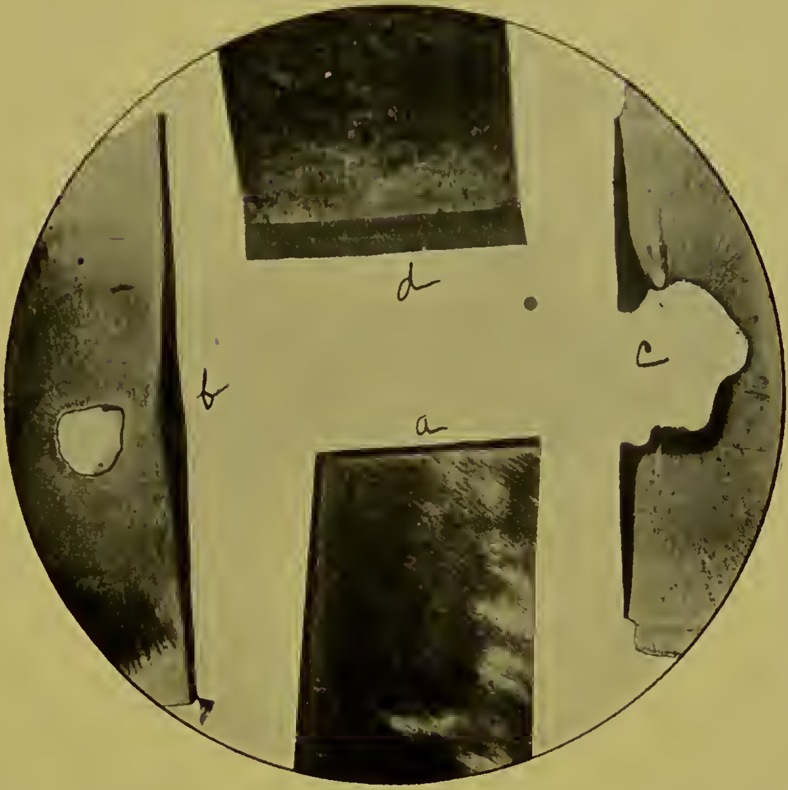
The principal solutions and mixtures made use of are the following:

1. Bouillon, consisting of water 100, beef extract 1.5, peptone 1.5, sugar 2 to 3, neutralized, sterilized, and infected with saliva.
2. The same solution mixed with equal parts of saliva.
3. Saliva with 2 per cent. to 4 per cent. sugar.
4. Mixtures made by chewing up bread and meat, sometimes adding milk or beer, although the latter especially has proved undesirable on account of the yeast fungi which may be introduced thereby into the cultures and which prove very annoying.

The teeth—either whole teeth or halves or sections—were suspended in those solutions by means of silk threads so that they might be equally subjected to the action of the acid on all sides. The solutions were often changed, in some cases daily, and at first were kept in the incubator. After the fermentation had taken place they were kept mostly at room temperature, although in some cases they remained in the incubator throughout the experiment.

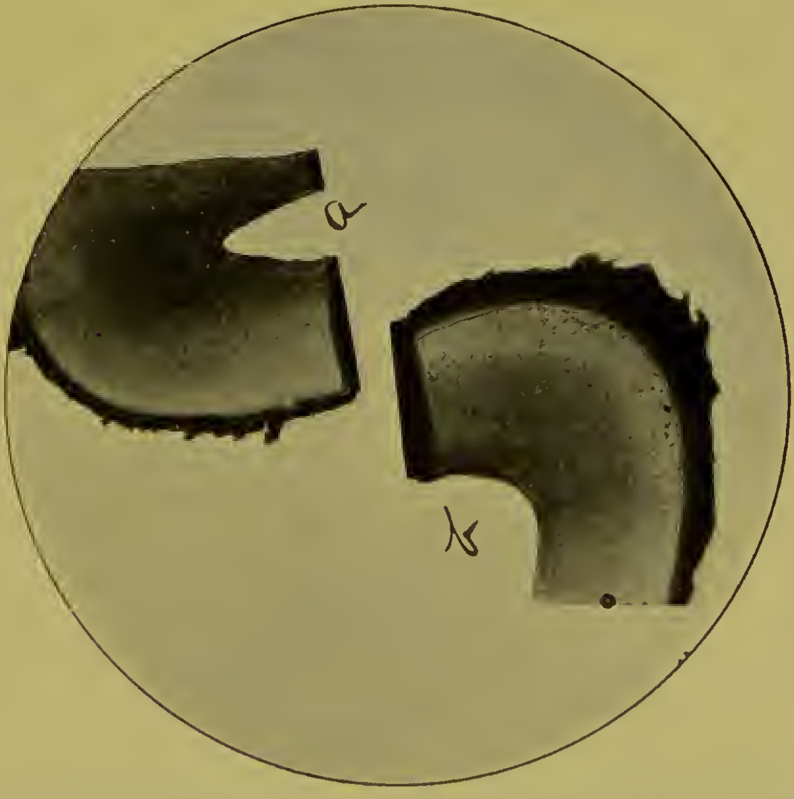
Great care must be taken to avoid contamination with molds, which consume the acid and finally convert the reaction into an alkaline one. If they have once established themselves there is nothing to be done but to take out the teeth, put them in 1 per cent. carbolic acid for from one to two days, and then begin the experiment anew.

Fig. 12.



Unequal decalcification of different kinds of dentin under the same conditions.

Fig. 13.



Unequal decalcification of tooth of an immune (*a*), and of a first molar of a child of ten; exposure, two months and eight days.

The object of the experiments was to compare deciduous teeth and so-called soft teeth with hard teeth in regard to their susceptibility to the action of acid.

At first I hoped to be able to establish such a difference by means of the staining test. The sections after remaining some hours in the solutions were removed and treated with a solution of eosin in the expectation that those which had been decalcified most would show a deeper staining. The results were, however, not sufficiently pronounced to admit of drawing any conclusions.

As the next step in this investigation ground sections of deciduous teeth and of hard and soft teeth were prepared, each 0.9 millimeter thick and suspended by silk threads in the fermenting solution. The time was then noted which was found necessary to soften (decalcify) the sections sufficiently to admit of piercing them with a needle. In all, seventy-five sections were treated in this way, with the result that in most cases no appreciable difference in the rapidity of the decalcification could be established; in a few cases only the hard sections evidently held out slightly longer than the soft ones.

In following up this line of work, teeth of all three categories were halved or ground down from the surface sufficiently to expose the dentin and suspended in the solutions in the manner described. After the lapse of periods of time varying from a few days to several months corresponding teeth were taken out and sections ground, always holding the decalcified margin of the section to the front (against the stone) to prevent dragging off the softened tissue.

In Fig. 12 we have a photograph showing the effect of a weak acid solution on the dentin from teeth of the sperm-whale, *a*, dog, *b*, man, *c*, and elephant, *d*. The decalcified layer (black in the photograph) is seen to be very thin in the dentin of the sperm-whale and thickest in ivory.

Here again no difference approaching that found between ivory and dentin of the sperm-whale manifested itself, though in many cases a very appreciable difference did appear.

Fig. 13 shows us the result of a comparison in which a marked difference appears. In this case the tooth of a man who up to a very old age had been completely immune to caries was halved and compared with a carious soft first molar of a child of ten. We see here a very considerable difference in the thickness of the decalcified layers.

In Fig. 14 we have a pronounced difference of hard dentin.

In Fig. 15 it will likewise be observed that the decalcification is considerably more extensive in the two pieces *a* than in *b*.

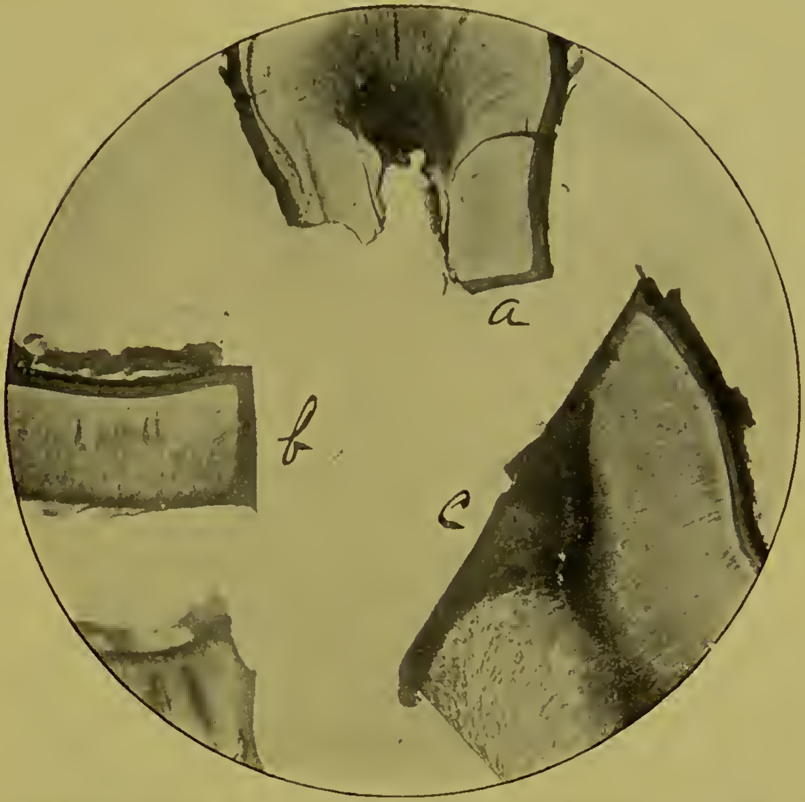
In this case solution 1 was diluted with an equal part of water in order to bring about a very slow action of the acid. It was thought that in this way any differences in the resisting power of the dentin might be made more prominent. The two sections *a* and *b*, in Fig. 15, are extremes chosen from eighteen cases.

In Fig. 16 I have reproduced the action of solution 4 on teeth hard (*a*), soft (*c*), and a sound deciduous tooth (*b*). We are here surprised to see that the deciduous tooth has held its own with the hard tooth, and in fact is slightly less acted upon, if anything.

Note the retarding action of the secondary dentin at *a*.

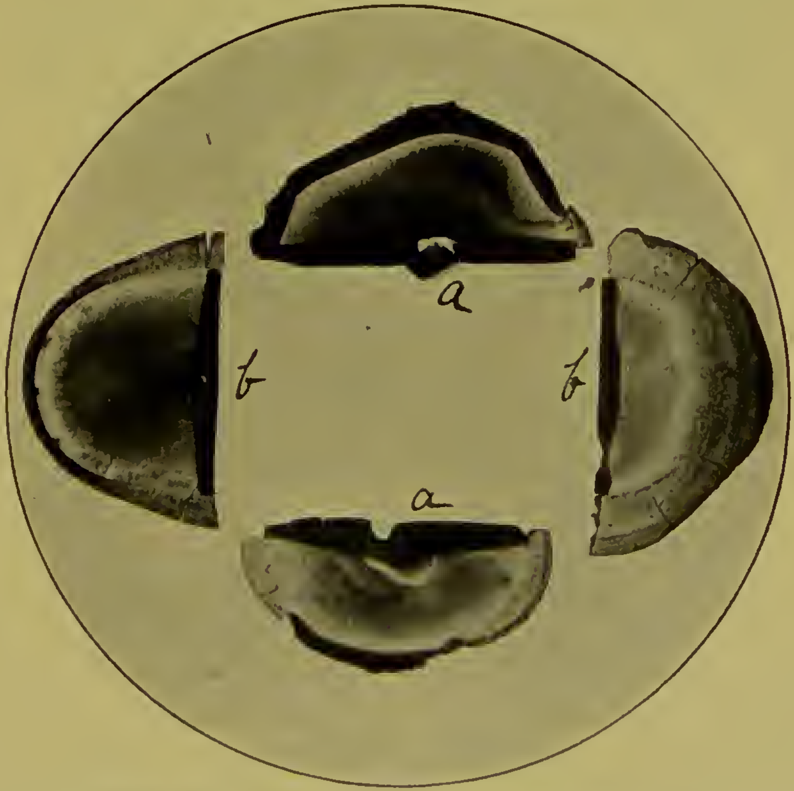
The result of all of my experiments has led me to the conclusion that there

FIG. 14.



Unequal decalcification of hard (*a*), soft (*b*), and deciduous (*c*) teeth; thirteen days.

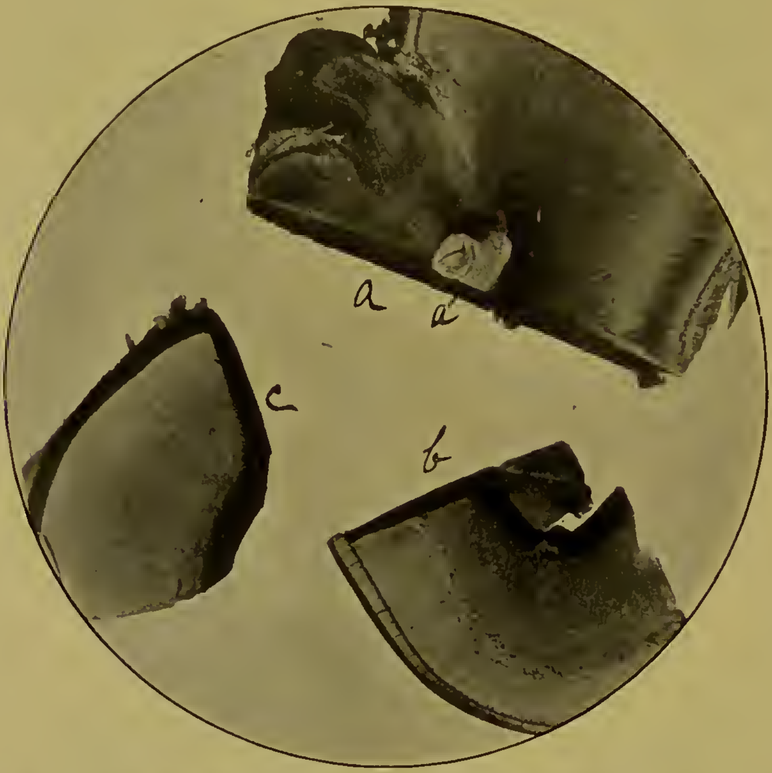
FIG. 15.



Unequal decalcification of dentin in solution 2 (see page 256); exposure, eight months.

is a difference in the rapidity with which dentin from different teeth is acted upon by weak acid under the same conditions, and that this difference will usually be found to be in favor of so-called hard dentin. The difference is not sufficiently great, however, to confer immunity upon the one tooth while the other falls a prey to caries. It is only one of the factors which, again, must not be completely lost sight of.

FIG. 16.



Comparison of tooth of an immune (*a*), with sound deciduous tooth (*b*), and soft tooth (*c*).

RESISTANCE OF ENAMEL IN DECIDUOUS AND IN "SOFT" AND "HARD" TEETH.

Experiments regarding the susceptibility of different teeth to caries would be very incomplete if only the dentin received consideration. The enamel offers a resistance to destructive agents, of whatever character, far greater than that of the dentin, and the protection which it affords to the teeth is of the greatest importance. This is plainly illustrated by Fig. 17, a photograph of a tooth which had been exposed for months to the action of very weak acids.

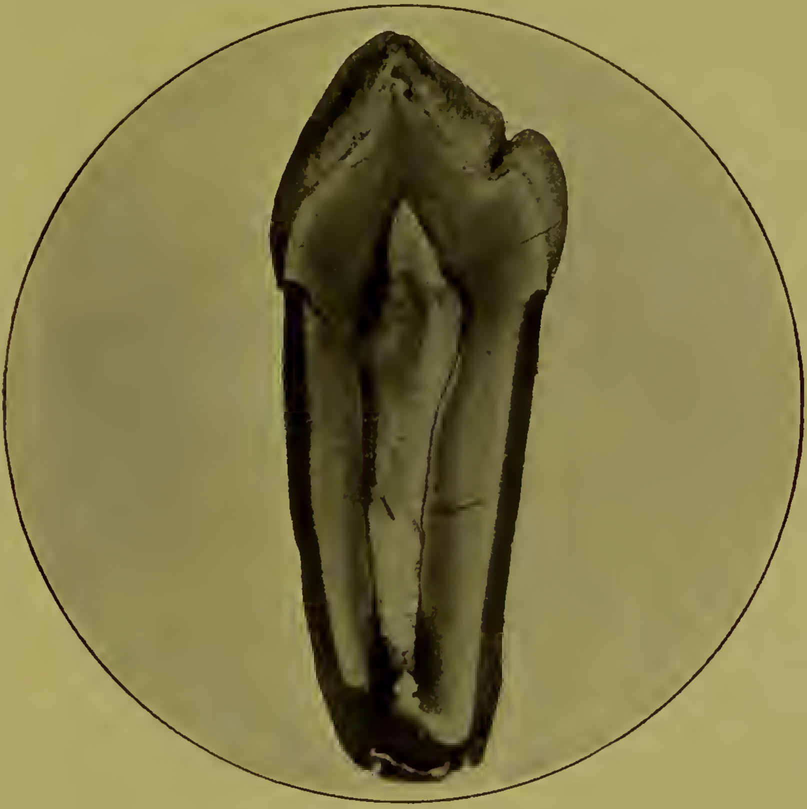
I wish here to refer first to a number of points brought to light by my investigations which are of considerable importance in helping us to a thorough understanding of the phenomena of dental caries.

In the first place I beg to emphasize the fact that in caries of the teeth the chemical destruction of the enamel takes place to a very great extent from within outward, and is very materially assisted by mechanical agents.

Typical cases illustrating this fact are shown in Figs. 18 and 19: slight action on external surface; penetration of the acid through a comparatively narrow channel into which food may be forced in the process of mastication; undermining and comparatively extensive action upon the internal surface, and, finally, breaking down of the enamel bridge by mechanical action.

Figs. 20 and 21 show the same features on the approximal surface and at the neck of the tooth.

FIG. 17.



Comparative action of acids on enamel and dentin. Tooth suspended for several weeks in solution No. 1.

The external intact smooth enamel surface offers a most stubborn resistance to the action of weak acids and far greater resistance than the internal surface. (Figs. 22 and 23.)

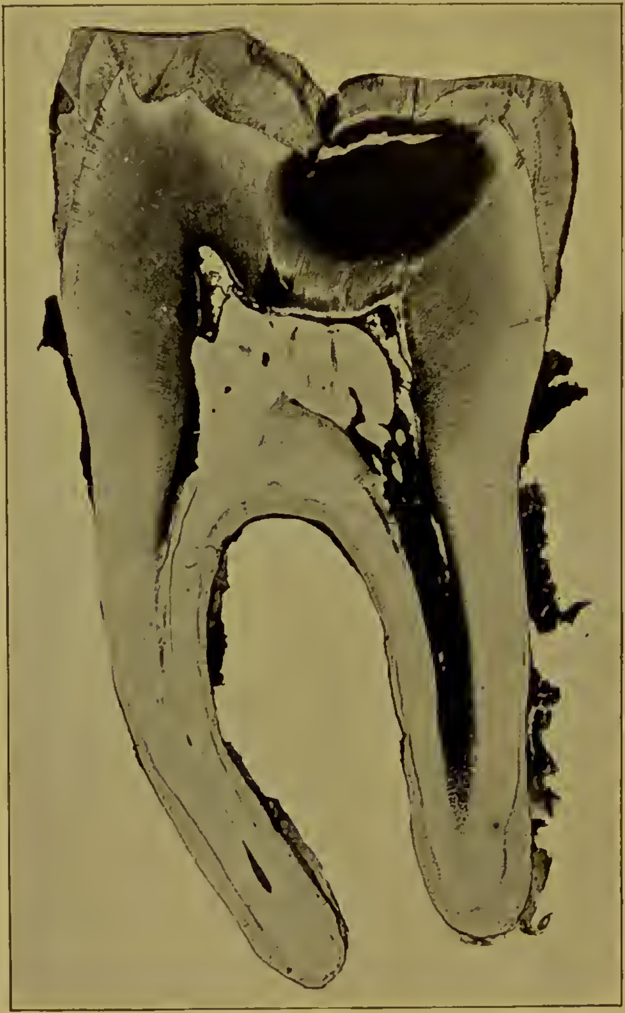
Fig. 23 shows a section of a hard tooth which had been ground down to expose the dentin and suspended in solution No. 1 for one year and nine months, the solution being repeatedly changed. The enamel externally where completely intact shows but slight disintegration, whereas the entire core of dentin had become decalcified as well as a considerable portion of the inner enamel surface.

Abrasions, bruises, cracks, or any other defects, natural or artificial, very sensibly diminish this resistance. This point is illustrated by Fig. 24, showing the effect of a bruise of the enamel surface caused by the forceps in extracting.

The resistance of the enamel appears to be due in part to the protective action of the enamel cuticle. Fig. 25 illustrates this. Here I have reproduced a section of a tooth which had been exposed to solution No. 1 for nine and a half months. It attracted my attention in particular because it showed a zone about 2 mm. broad which did not appear to have been affected in the least, while the rest of the surface was white and chalky. On subjecting this tooth to the action of a 5 per cent. solution of hydrochloric acid I found that the zone mentioned was still covered by the enamel cuticle, which was wanting on the other parts. This as well as other observations have led me to the conclusion that the enamel cuticle furnishes a certain protection to the tooth and should not be wantonly destroyed in dental operations.

It is also worthy of notice in this connection that in dental caries the enamel cuticle is not simply lifted up from the surface of the tooth, as it is by hydrochloric or nitric acid. A tooth may remain for months in fermenting solutions and the enamel undergo considerable decalcification without losing the enamel cuticle. Fig. 26 illustrates this fact. This tooth had been suspended for two months in mixture No. 4 and was decalcified to a considerable depth. On exposing a section to a 5 per cent. solution of hydrochloric acid the enamel cuticle

Fig. 18.



Undermining caries; destruction of tooth-substance from within.

was brought to view as seen in the photograph.

The same is true also to a surprising degree in natural caries of the teeth. Subject, for example, a tooth showing a decay mark (caries nigra) to the action of a 2 to 5 per cent. solution of hydrochloric acid, and we find that the enamel cuticle not only makes its appearance on the sound surface but on the margins of the decay mark where considerable decalcification of the enamel has taken place. In the center of those marks the cuticle appears to be glued down to the surface of the enamel, although the caries process may have already reached the dentin. (Figs. 27 and 28.) It adheres tenaciously to the surface of the decayed enamel, and when it finally comes away after prolonged action of the acid it usually carries fragments of the enamel prisms with it. Where there has been a loss of substance the cuticle is naturally wanting.

This gluing of the cuticle to the surface of the decay marks may explain the remarkable fact that such marks offer much more resistance to the action of acids than does the healthy enamel.

In Fig. 29 I have reproduced a section of tooth having a characteristic black spot (decay mark) on the approximal surface. This tooth was kept for two months in solution No. 4 and repeatedly brushed with a tooth-brush. The sound enamel was dissolved away around the decay mark, leaving it standing as seen in Fig. 29 at *a*.

Another property of the enamel was brought to light by my experiments which appears still more important than the behavior of the enamel cuticle. The external surface of the enamel seems to be protected by a thin layer or crust which offers a marked resistance to the action of acids in comparison with the deeper layers. Wherever this crust, which is only a fraction of a millimeter thick, is mechanically removed, the acid at once acts far more rapidly upon the enamel than otherwise. This point is clearly illustrated by Fig. 30.

The same fact is clearly brought out by the action of acids upon sections of enamel cut parallel to the enamel prisms. Here the deeper layers of enamel are eaten away, while the external crust is comparatively untouched and remains standing as a jagged point. (Fig. 31.)

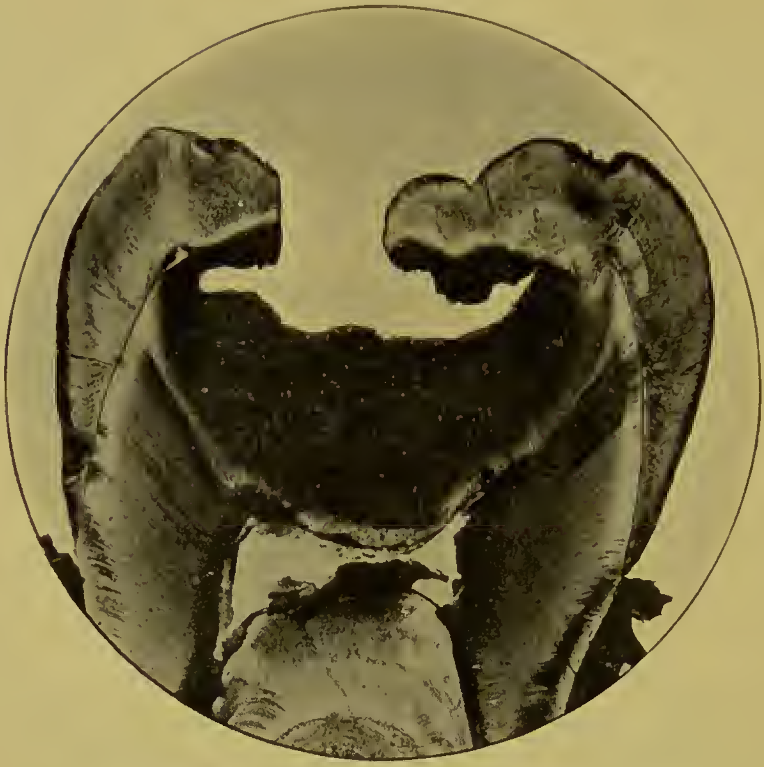
This, then, may in part account for the fact that approximal facets in cases where the outer crust is worn away not infrequently become the starting-point of caries. (Figs. 32 and 33.) In acid mixtures or solutions they are invariably much more affected than is the normal enamel surface.

We recognize here the necessity of preserving this external layer and avoiding unnecessary filing *where the filed surface is not self-cleansing.*

Deep fissures are to be considered as particularly weak points in the enamel armor, and are universally recognized as such. Similarly all defects in the enamel which furnish a lodging-place for food, and likewise cracks and weak lines in the enamel *in all places which lie within the focus of infection,* inasmuch as acid penetrates the enamel more rapidly along such defects. (Fig. 34.)

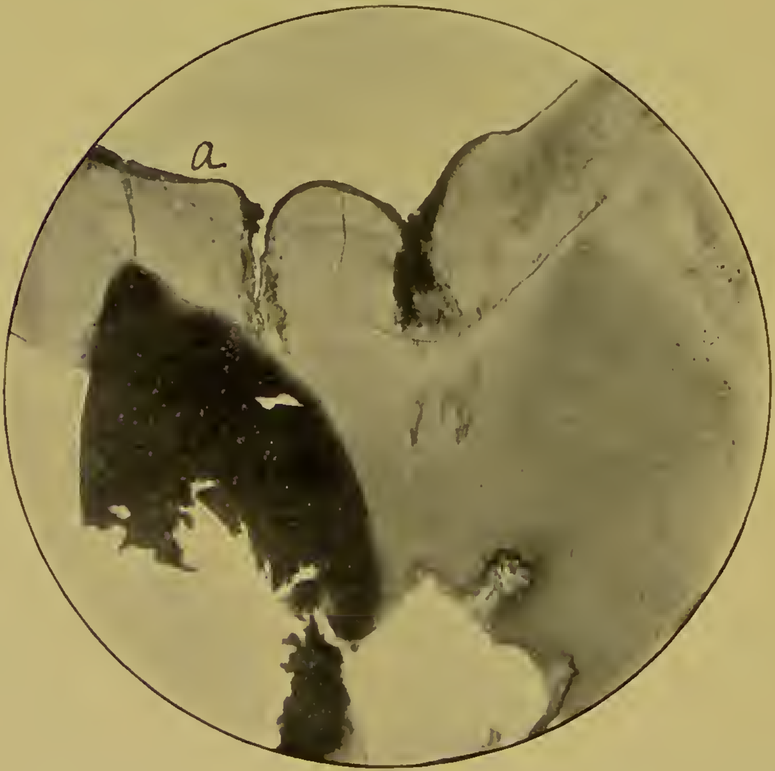
The argument that defects of structure do not dispose teeth to caries because the enamel of various animals shows such defects and still does not decay is not valid. We might as well say that heat has no effect on the inhabitants of Greenland because no Eskimo as long as he stayed at home was ever known to suffer from sunstroke. Naturally a defective tooth

Fig. 19.



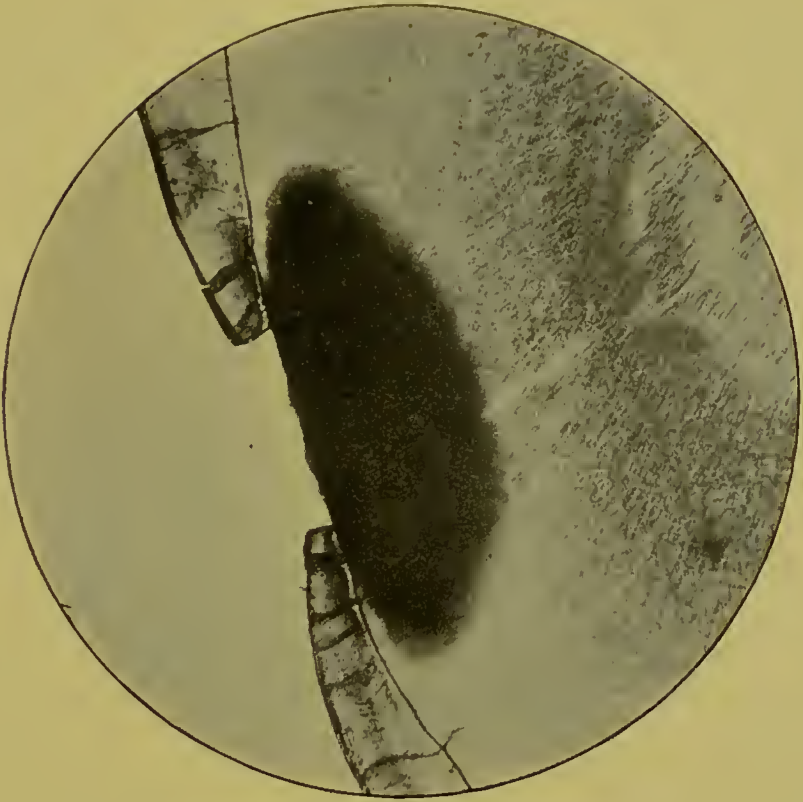
Undermining caries; destruction of tooth-substance from within.

Fig. 20.



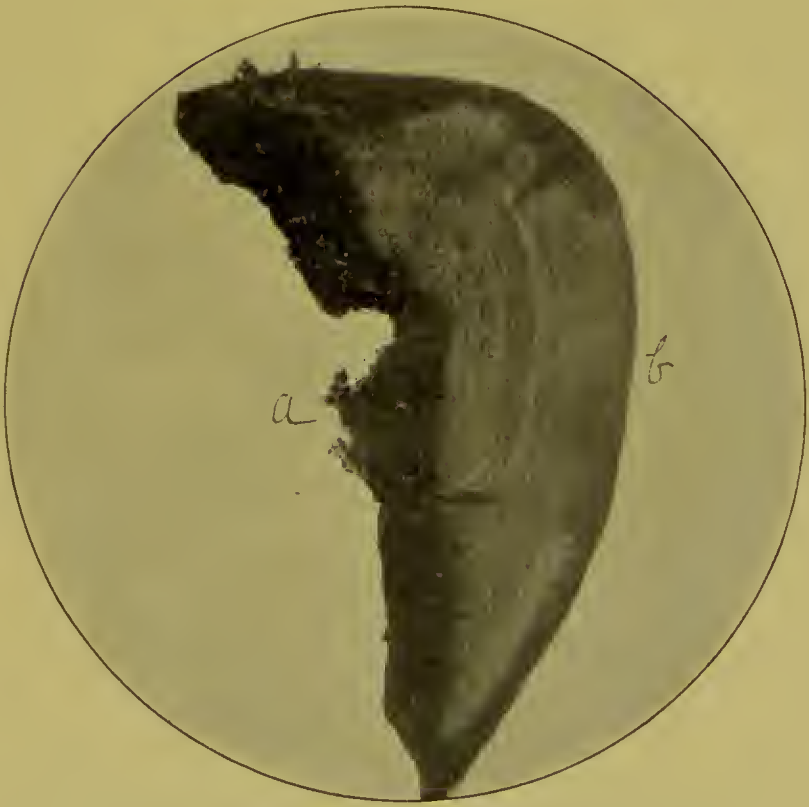
Undermining caries of approximal surface; undecayed enamel cusp (*a*) about to break away.

Fig. 21.



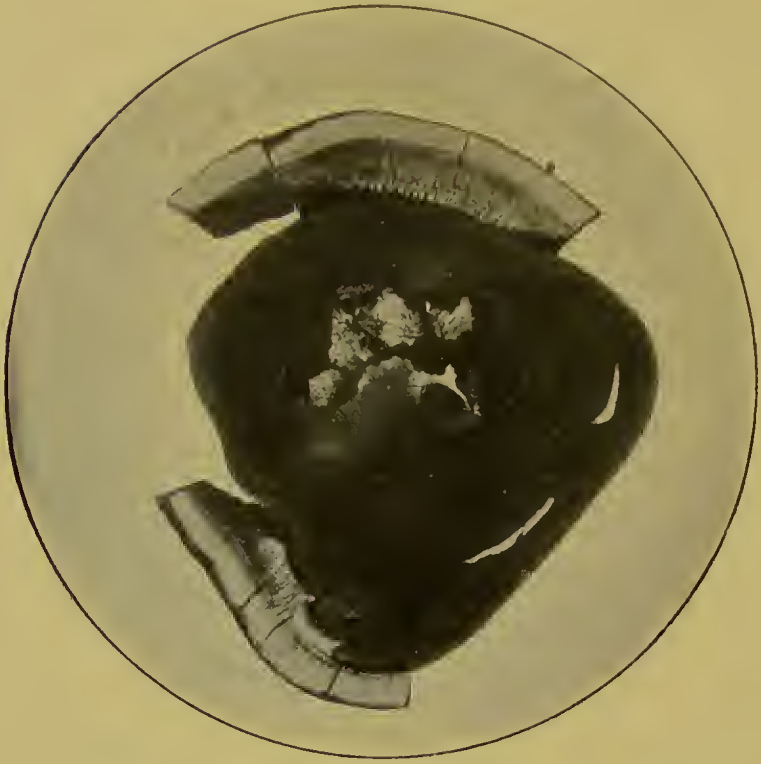
Undermining caries near neck of tooth.

Fig. 22.



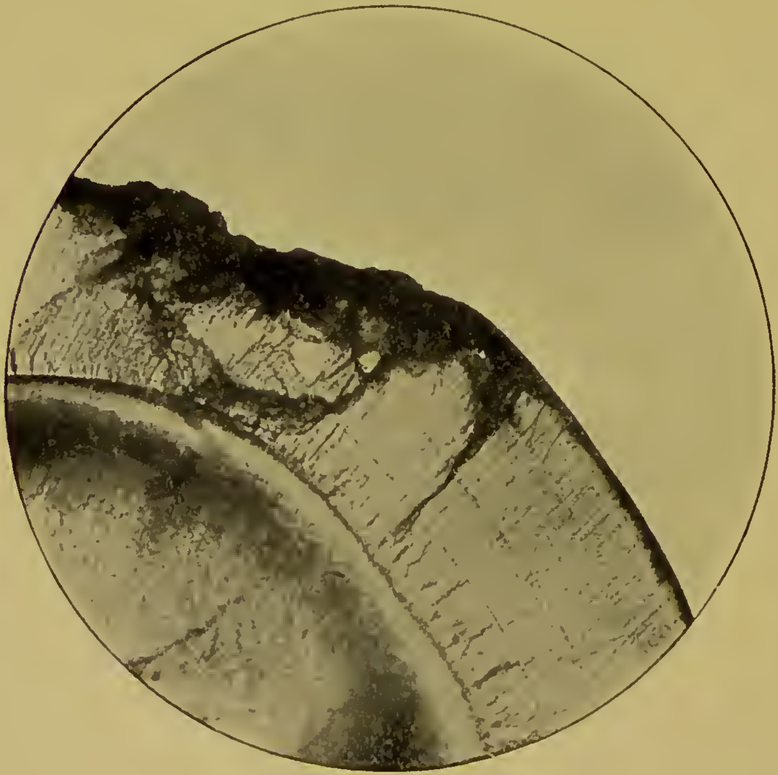
Unequal action of acid upon internal (*a*) and external (*b*) surfaces.

Fig. 23.



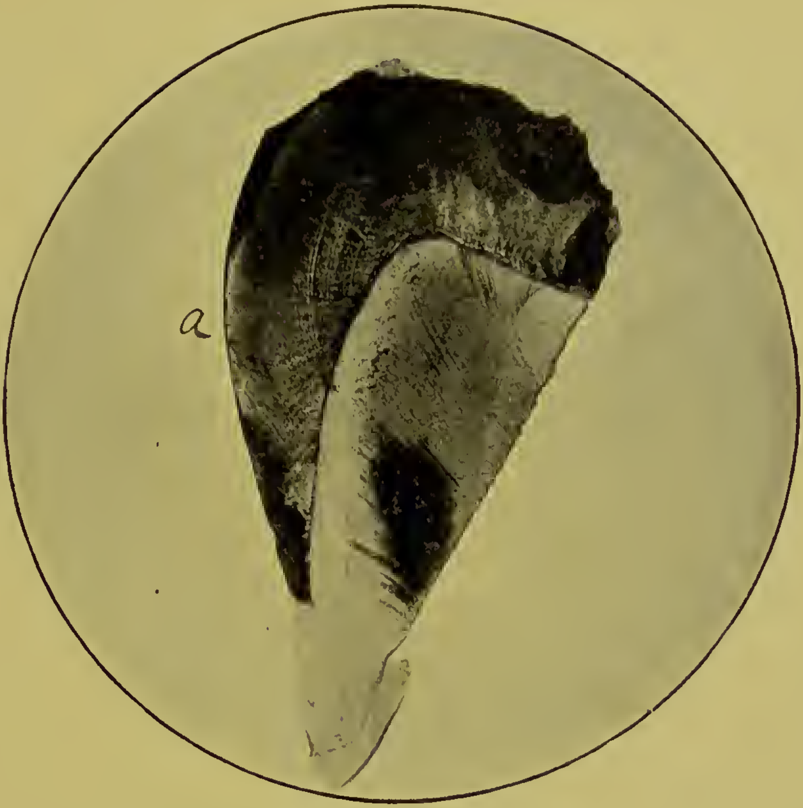
Marked resistance of external surface of enamel compared with the total decalcification of dentin and breaking away of enamel walls from within.

Fig. 24.



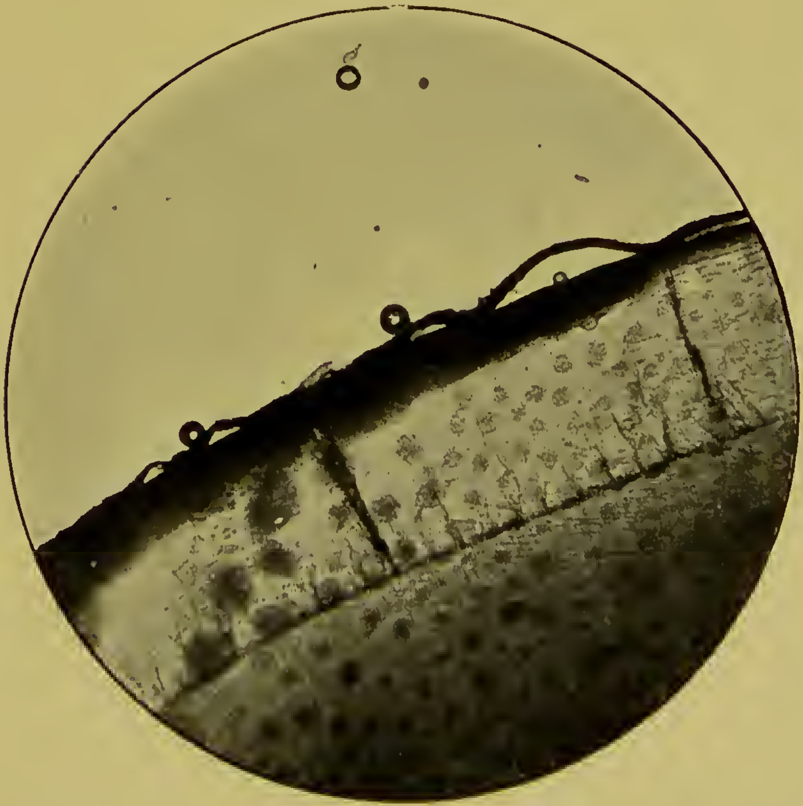
Action of acid upon bruised surface.

FIG. 25.



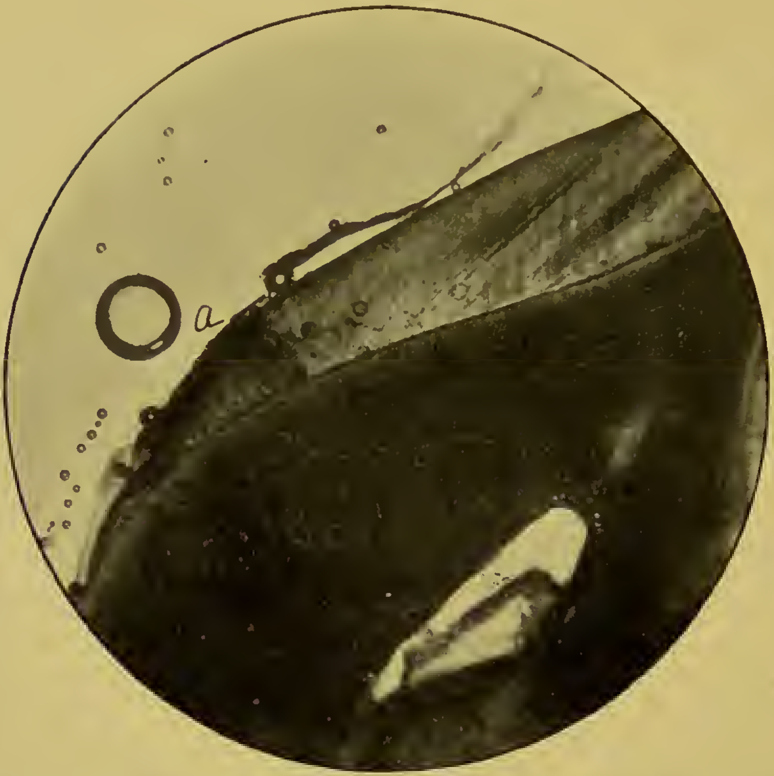
Protective action of enamel cuticle (at *a*).

FIG. 26.



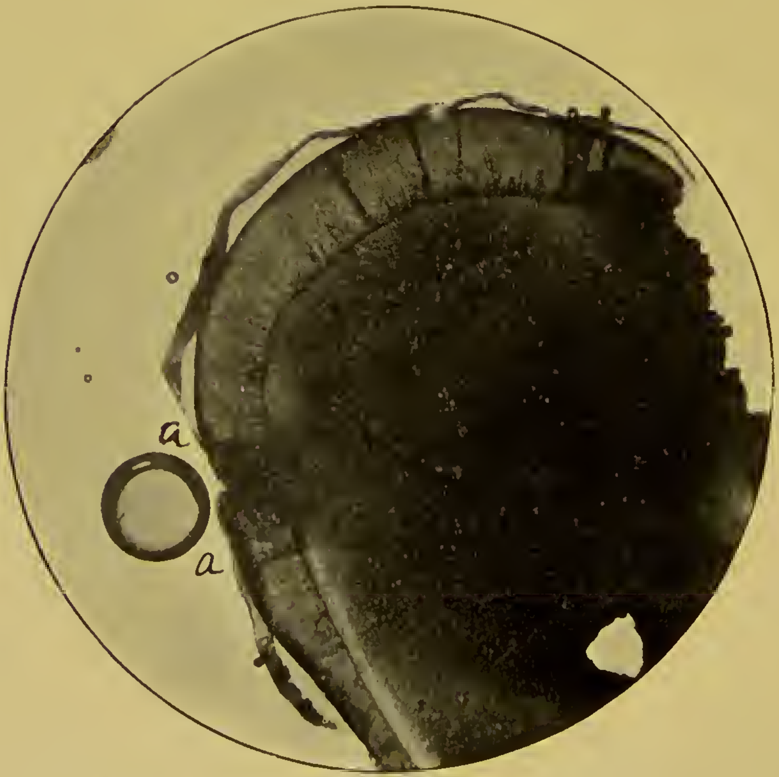
Thickened enamel cuticle on tooth kept for two months in a bread-saliva mixture and decalcified to a considerable extent.

FIG. 27.



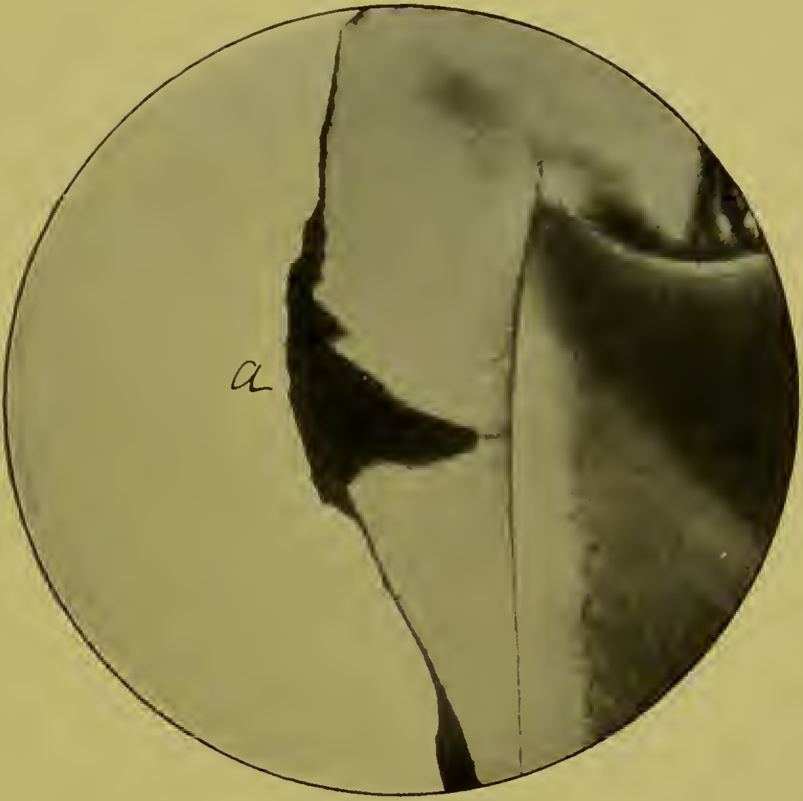
Enamel cuticle under the action of hydrochloric acid still adherent to decayed surface (at *a*).

FIG. 28.



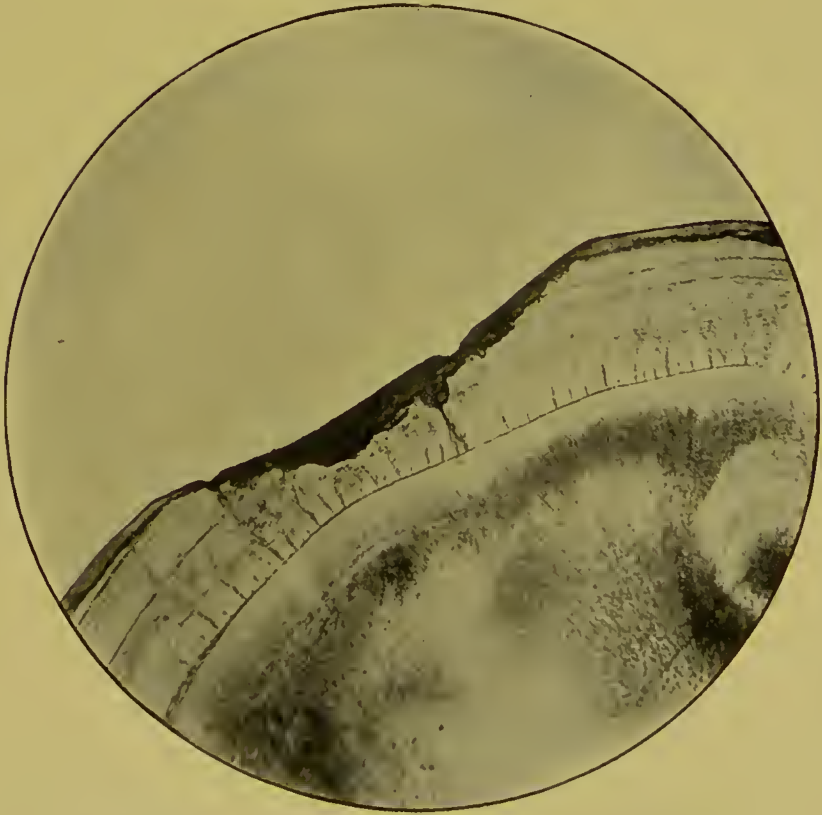
Enamel cuticle under the action of hydrochloric acid still adherent to decayed surface (at *a*, *a*).

FIG. 29.



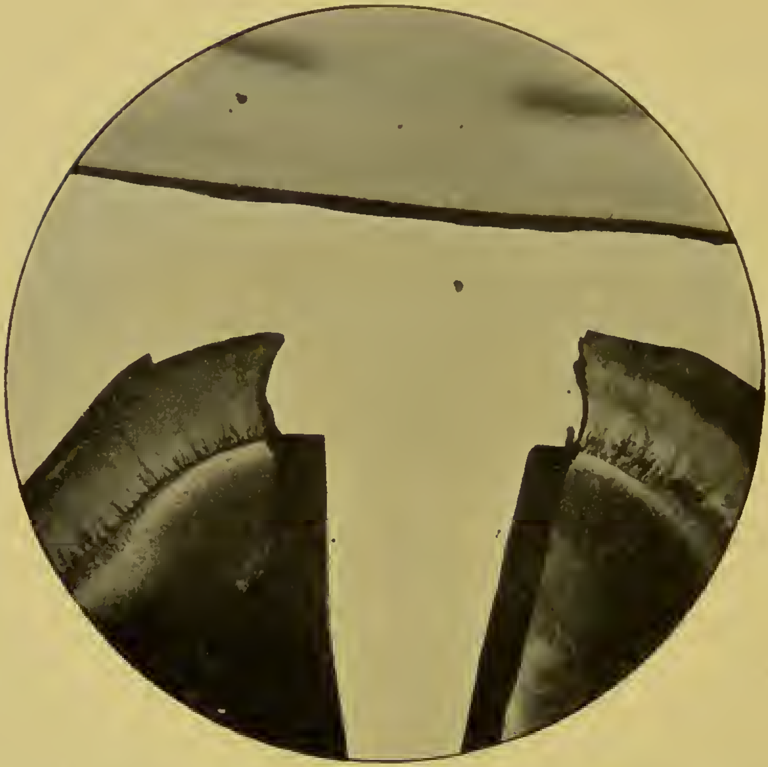
Decay mark (*a*) resists action of acid and brush more than does sound enamel.

FIG. 30.



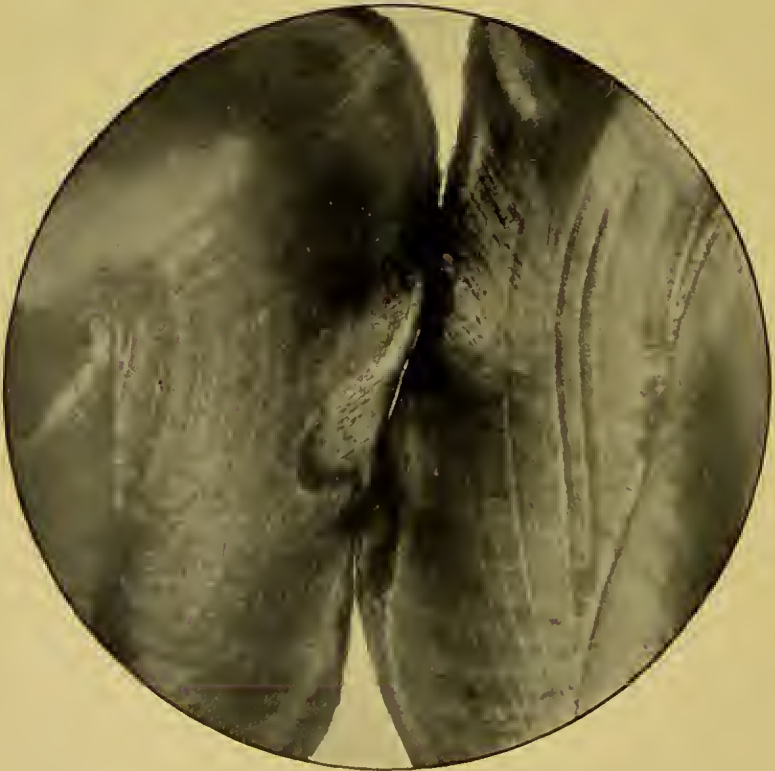
Increased action of acid due to loss of external layer of enamel.

FIG. 31.



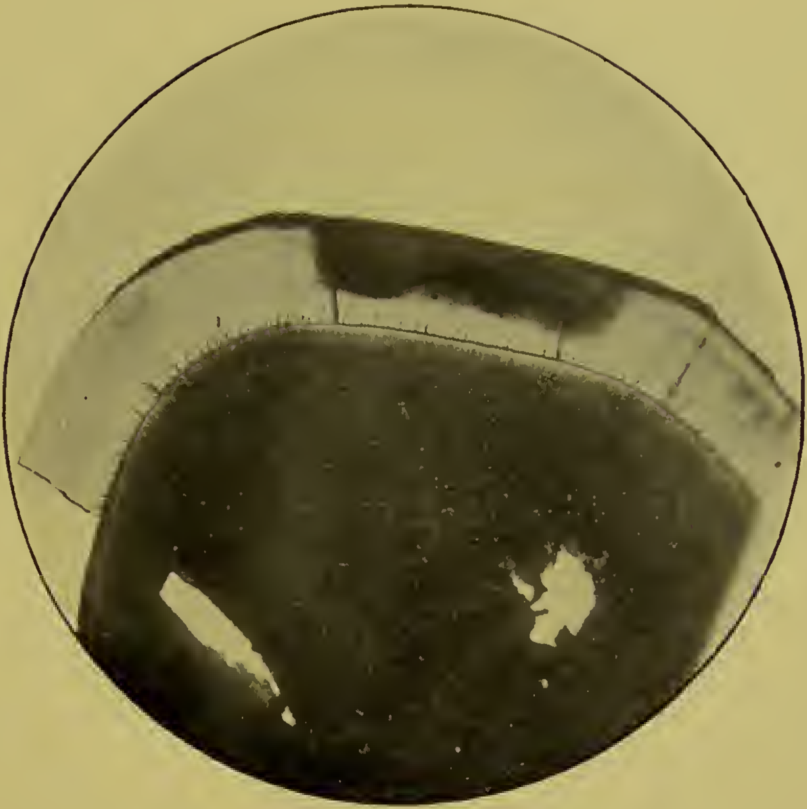
Superior resistance of external enamel crust. In the left piece both enamel and dentin have suffered more than in the right. Time, two and one-half months.

FIG. 32.



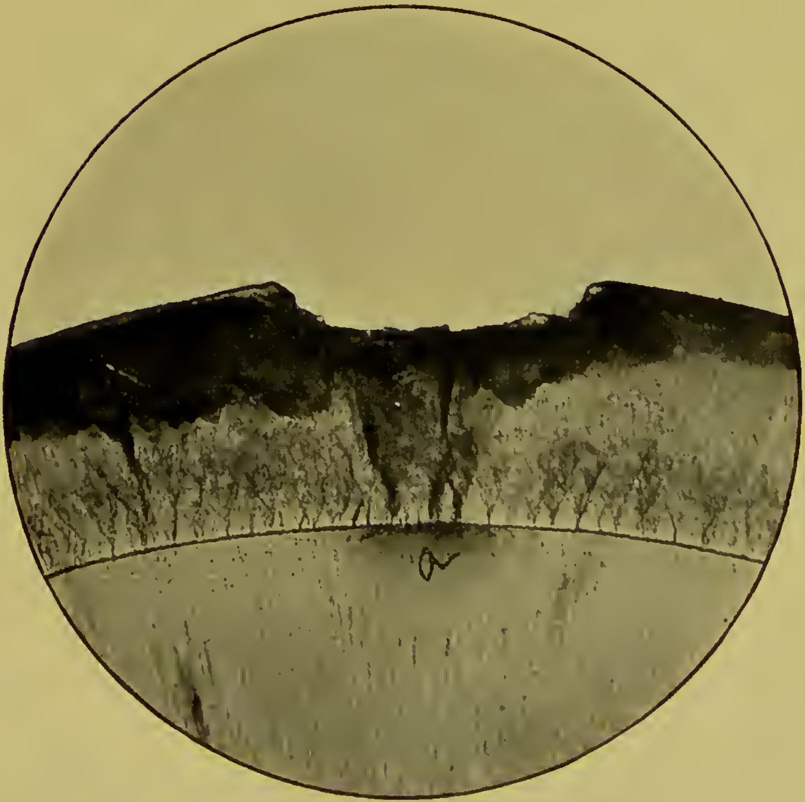
Increased susceptibility of approximal facet to decay.

FIG. 33.



Increased susceptibility of approximal facet to decay.

FIG. 34.



Acid penetrating through weak lines in enamel: undermining caries beginning (at *a*).

FIG. 35.

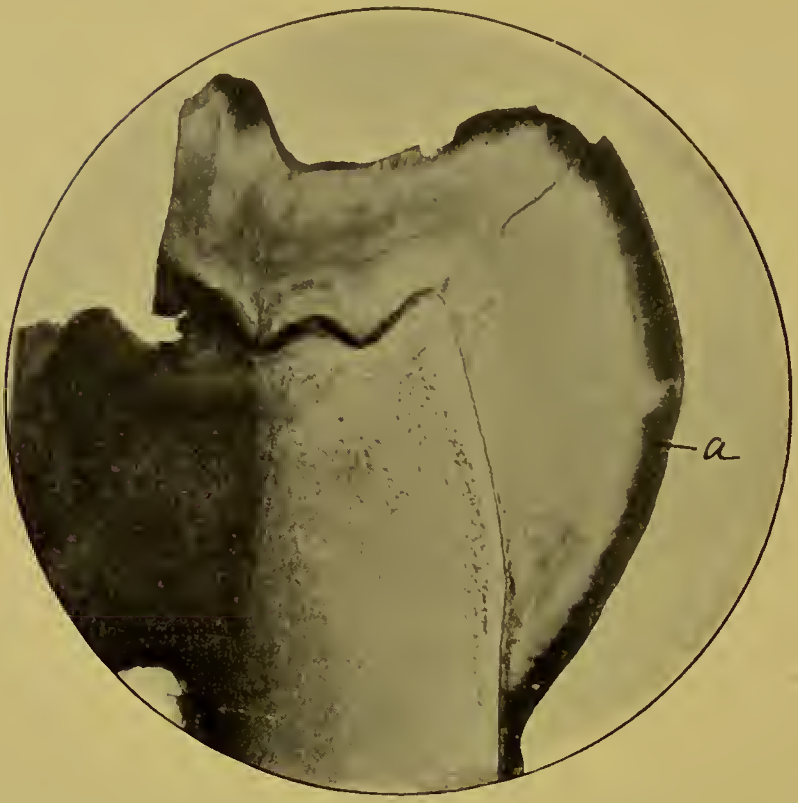
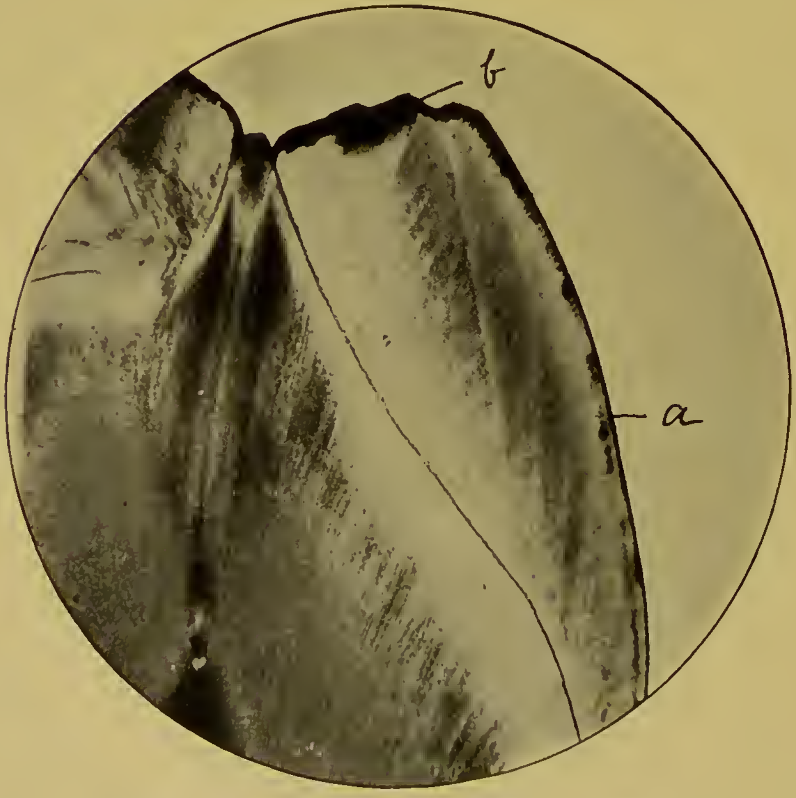


FIG. 36.



FIGS. 35 AND 36. Fig. 35, a soft not fully developed first molar; Fig. 36, a hard yellowish bicuspid: suspended for three months in the same solution. *a*, Decalcified layer of enamel. Note that the decalcification is several times more extensive in Fig. 35 than in Fig. 36; also that the abraded surface (*b*) in Fig. 36 is much more affected than the smooth surface (*a*).

will not decay in the mouth of an animal which does not suffer from caries: no more will it if we put it away in a box. The teeth of many animals have deep fissures and still do not decay, but we should be allowing ourselves to be led astray were we to conclude from this that in the human mouth such fissures do not predispose the tooth to decay.

Whenever any tooth or any surface of a tooth is subjected to influences which produce caries, then weak points in that tooth, whether in the form of fissures, cracks, abrasions, or faulty development, will favor the attacking agents and accelerate the progress of decay.

The conclusions drawn from my experiments are supported by the facts of daily observations in practice and are illustrated by the foregoing photographic reproductions.

The question whether the sound enamel of the teeth of different persons, or of different teeth of the same person, shows different degrees of resistance to the action of acids was made the subject of a large number of experiments, in which the action of fermenting solutions as well as of mixtures of saliva and foodstuffs upon the enamel of deciduous teeth and of so-called hard and soft teeth was determined. The separate experiments extended over a period varying from a few days to one year and nine months, and a few of the results are given in the accompanying photographs.

The results of those experiments leave little room for doubt that the enamel of the teeth of different persons, as well as of different teeth of the same person and of different parts of the same teeth, does show differences in resistance to the action of acids; likewise the thickness of the enamel cap as exemplified in Fig. 40, as well as the integrity of the enamel surface, freedom from fissures, bruises, cracks, weak lines of imperfectly calcified prisms, etc., as far as these come within the sphere of infection. Here too, however, we must avoid exaggeration. My experiments have led me gradually to the conclusion that there is no one all-predominating factor which accounts for immunity or susceptibility to caries, but a large number of factors, part of which are to be sought for in the teeth themselves and part in their surroundings. So, too, the resistance of the enamel is only one of those factors, and its importance will be found to vary greatly in different cases.

I have occasionally found a tooth which I had classed with the soft variety to offer as much resistance as one which I had pronounced hard, and at present I have a deciduous tooth under experiment which appears to hold its own with the best permanent teeth.

INFLUENCE OF THE VITALITY OF THE TOOTH ON THE PROCESS OF CARIES.

It is a recognized fact that the pulps of teeth suffering from caries in not too acute form very often respond to the irritation conveyed to them through the contents of the dentinal tubules by throwing up a wall of secondary dentin and thus opposing a barrier between the pulps and the advancing disease by which its life and that of the tooth may be considerably prolonged. (Fig. 43.)

It is a disputed question, however, whether any changes of an active nature take place within the substance of the dentin already formed. There are those who insist on the view that the hard tissues of a fully developed tooth are not subjected to nutritive or reactive processes of any nature, and that these tissues comport themselves in a completely passive manner in the process of decay.

Fig. 37.

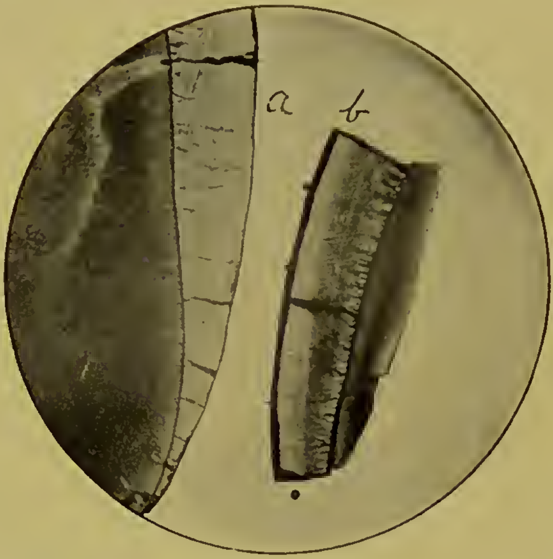
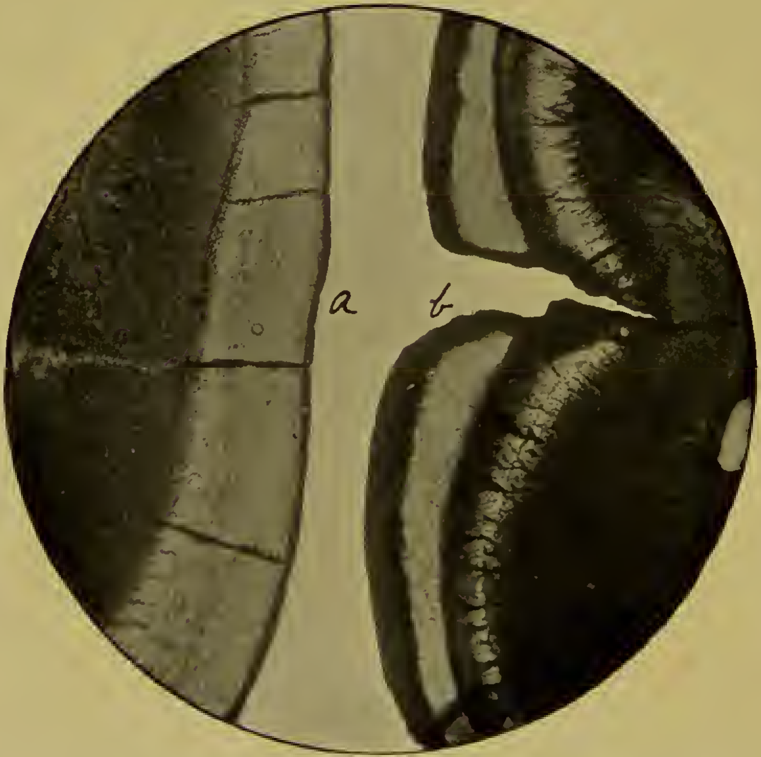


Fig. 38.



Figs. 37 and 38. Comparative action on hard enamel (*a*) and soft enamel (*b*). Fig. 37 three months, Fig. 38 ten and one-half months, in solution No. 1.

This is probably the case as far as enamel is concerned, but it is certainly not true in reference to the dentin, as is abundantly proved by the changes of a reactionary nature (increased transparency) so often accompanying caries of teeth with living pulps.

The question here to be considered is

FIG. 39.

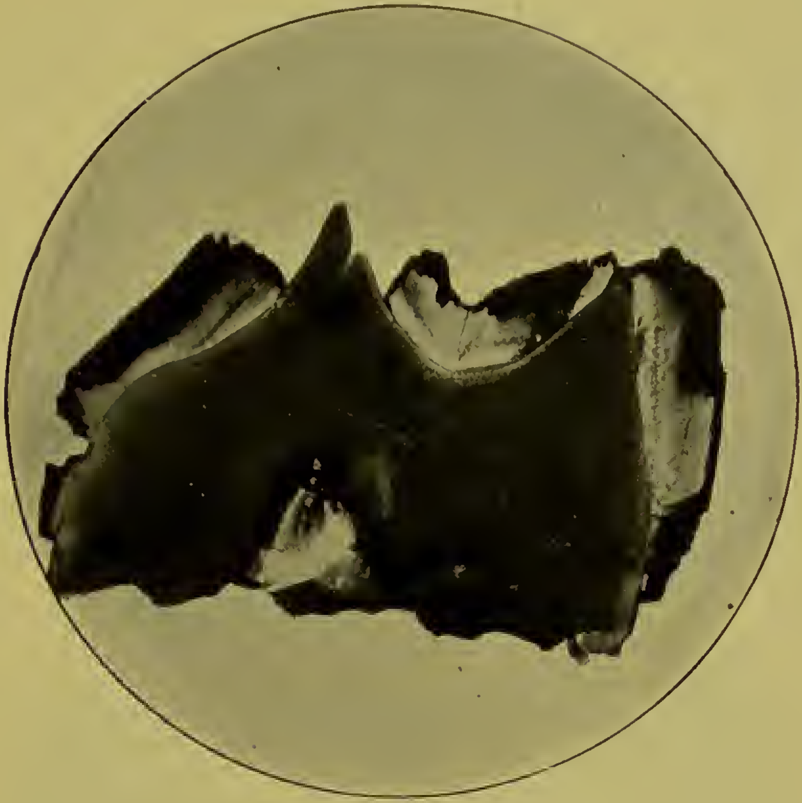
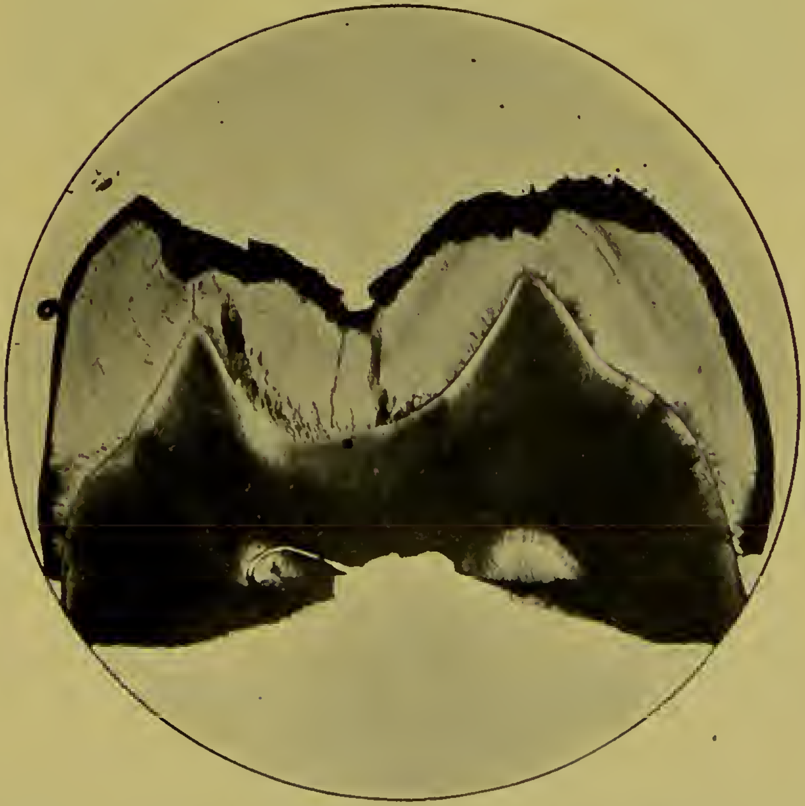


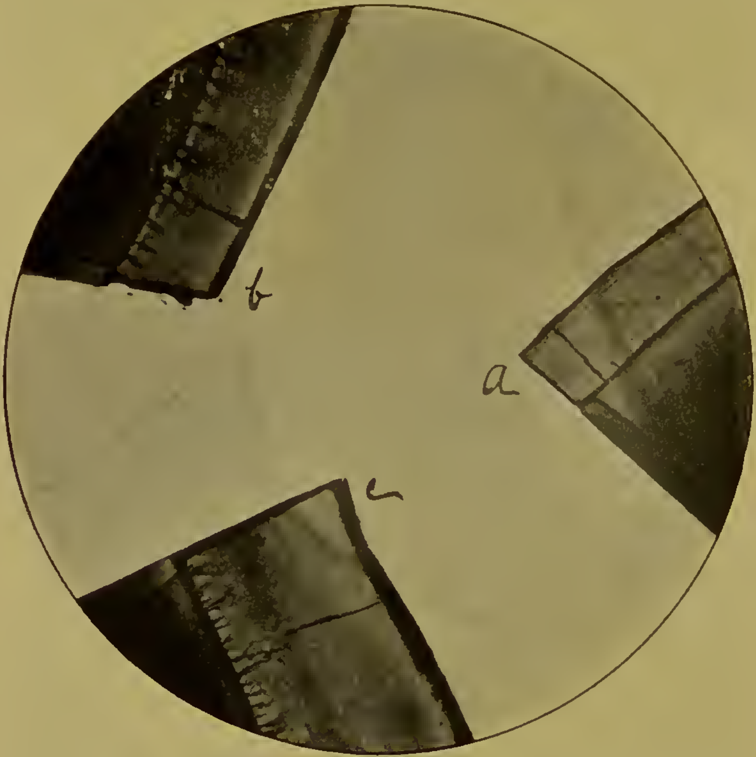
FIG. 40.



FIGS. 39 AND 40. Fig. 39 soft, Fig. 40 hard tooth, eleven months and twenty-six days in solution No. 1. Almost total destruction of enamel of soft tooth. Note also that the thickness of the enamel cap and the absence of a deep fissure are in favor of the hard tooth.

whether the appearance of a zone of increased transparency in front of the advancing caries in any way affects the progress of the disease. It is useless here to appeal to practical experience, because this has given us only conflicting answers; the truth in the matter being that the practitioner is as a rule so intent on the fulfilment of his task from a therapeutic point of view that he gives little or no attention to the etiology. I am of opinion that the zone of transparent dentin opposes a certain resistance to the advance of caries over and above that offered by normal dentin. This view receives encouragement from such preparations as that shown in Figs. 44 and 45.

FIG. 41.



Comparative action on hard (*a*), soft (*b*), and deciduous (*c*) tooth.

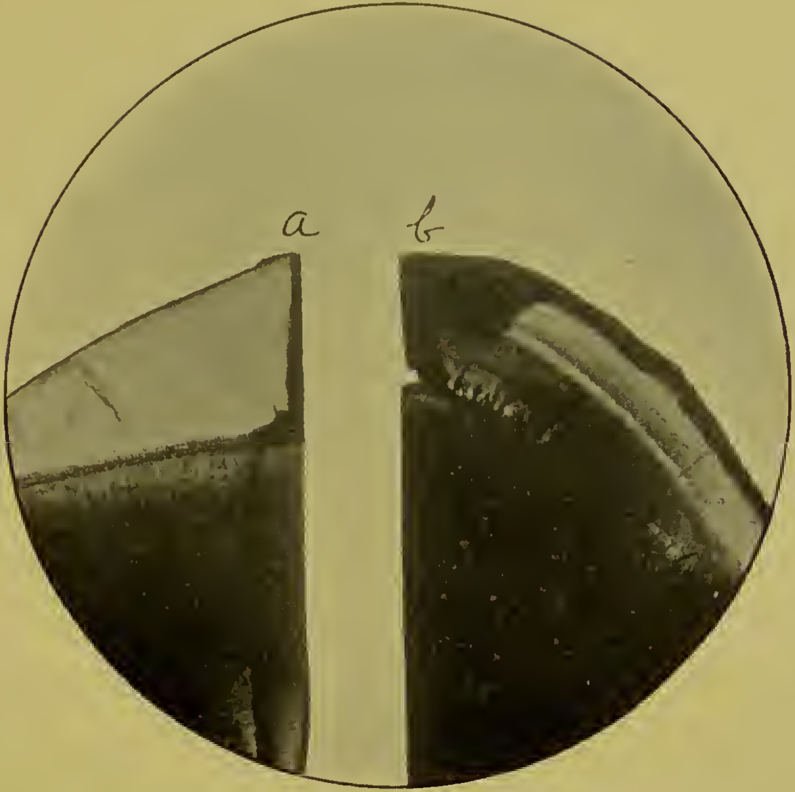
An acid acting upon dentin of equal resistance in all parts advances in a regular line or surface more like that seen in Fig. 45, certainly not as is seen in Fig. 44 at *a*. Here we get the decided impression that the transparent dentin is retarding the process of decalcification. Likewise in Fig. 45, left side, the decay is held back at *a*.

The evidence in these cases, however, not being conclusive, it became necessary to subject the matter to the experimental test.

Teeth suited for the purpose were ground down sufficiently to expose transparent zones and were exposed to the fermented solutions. After the lapse of from two to eight days sections were ground, of which a few are reproduced in the photographs Fig. 46-50.

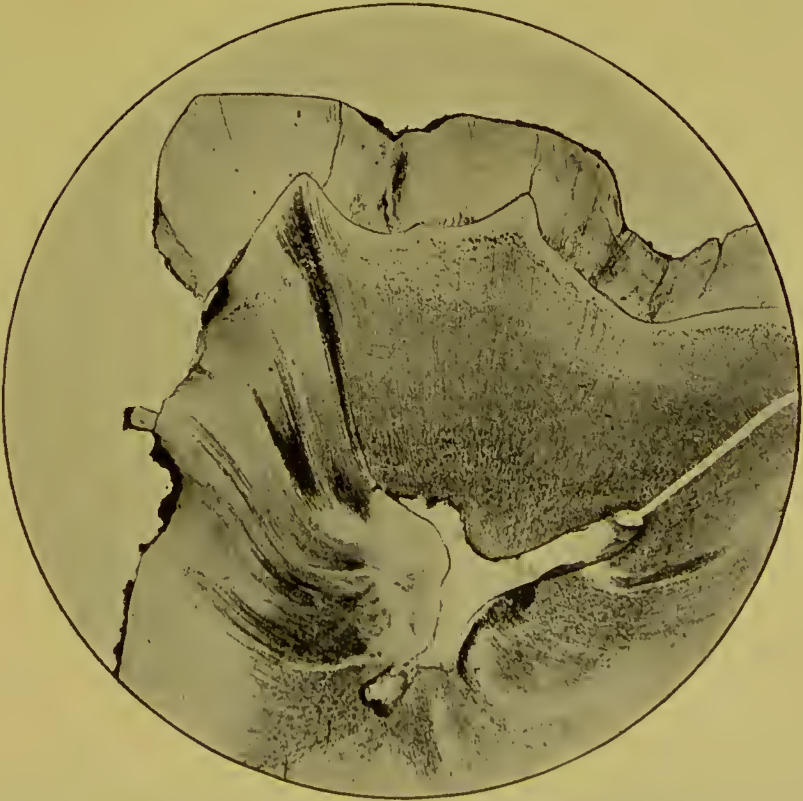
Fig. 51 presents us with a phenomenon which must still receive consideration. Two first molars exhibiting the process of self-healing were ground

FIG. 42.



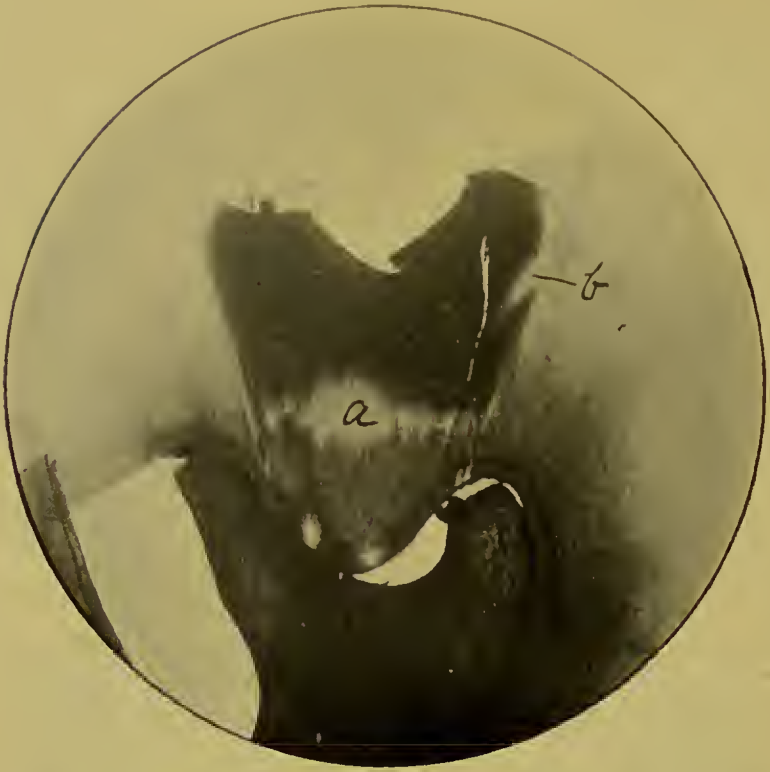
Comparative action on enamel of the tooth of an immune (*a*) and the soft first permanent molar (*b*).

FIG. 43.



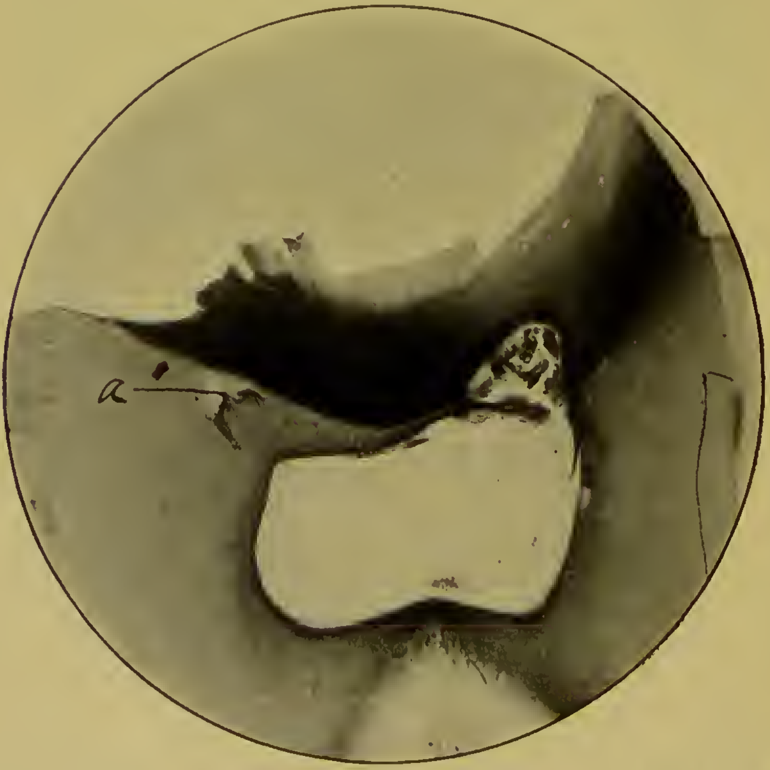
Deposit of secondary dentin due to chronic caries at the neck of the tooth.

FIG. 44.



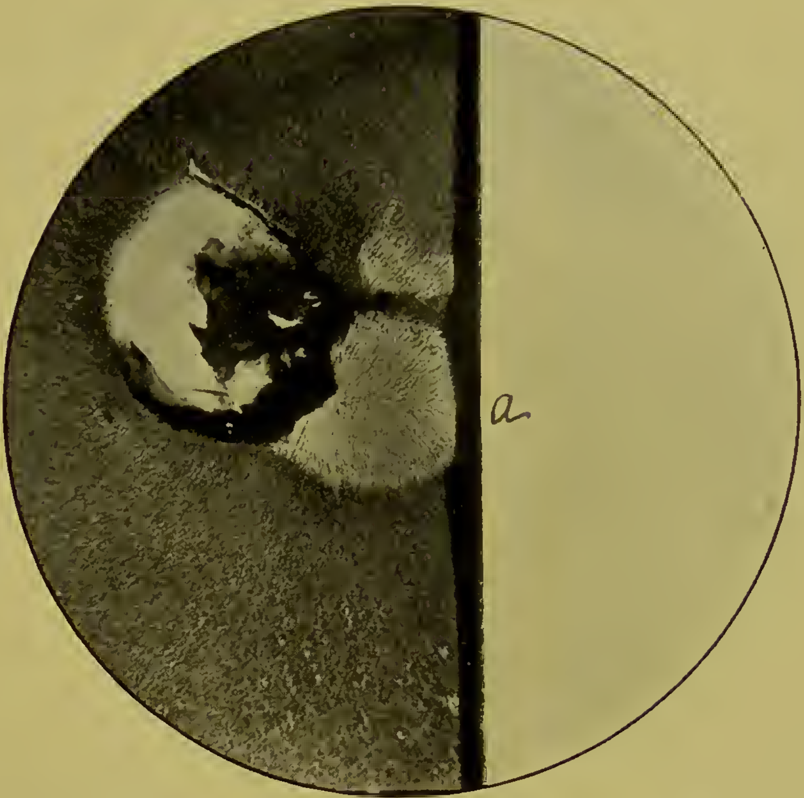
Apparent resistance of transparent dentin to progress of caries (at *a* and *b*).

FIG. 45.



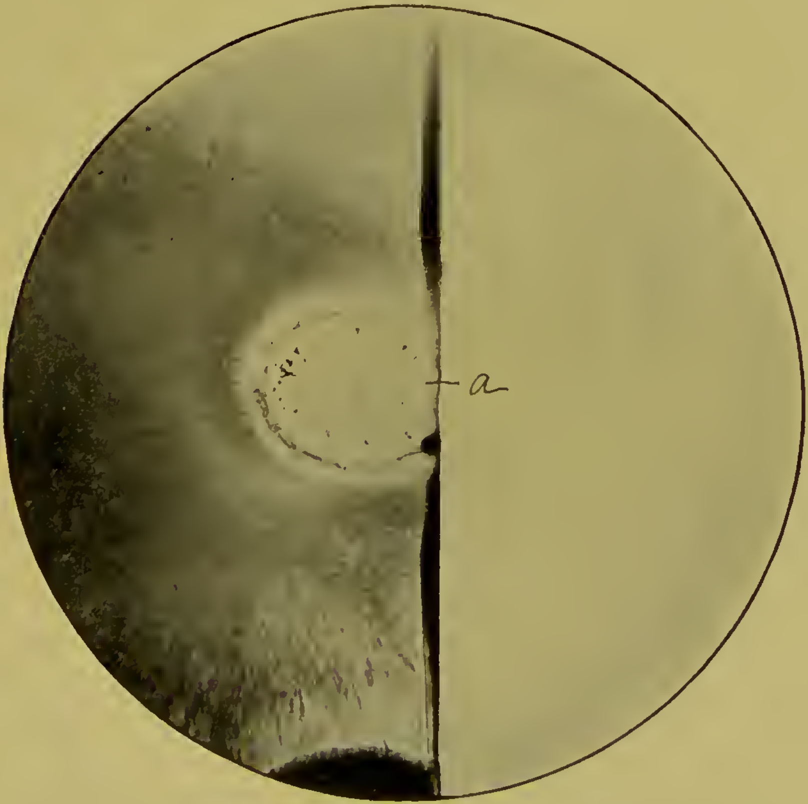
Transparent dentin (at *a*) due to pathological process previous to the present acute caries. It apparently resists the advance of the decalcification.

FIG. 46.



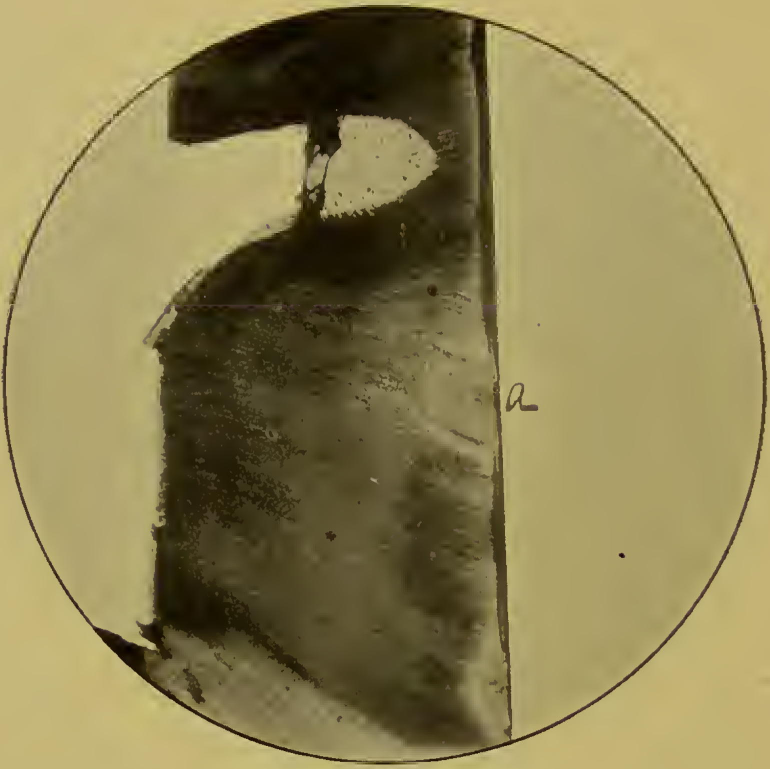
Evident superior resistance of secondary dentin to decalcification (at *a*).

FIG. 47.



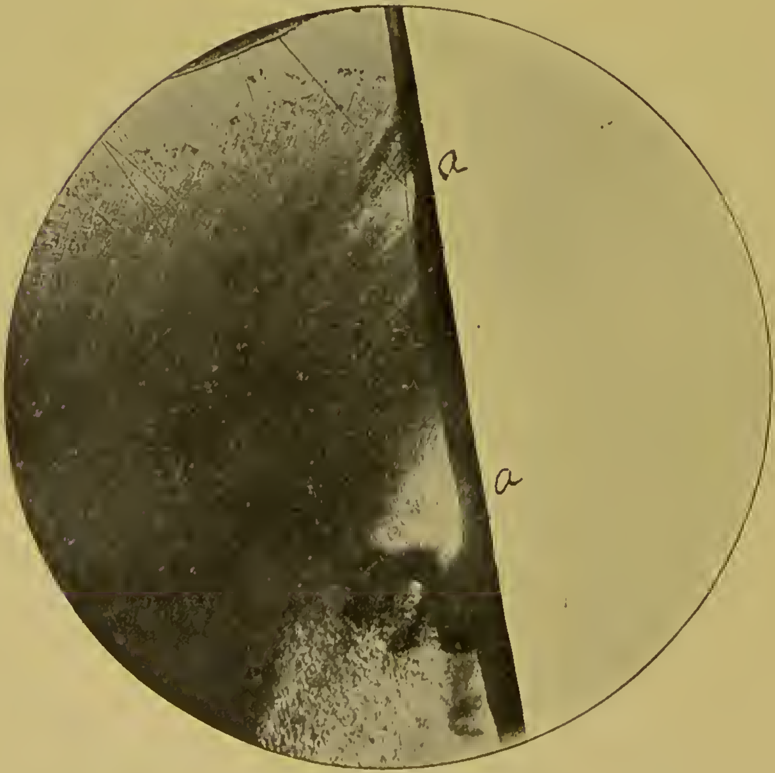
Evident superior resistance of secondary dentin to decalcification (at *a*).

FIG. 48.



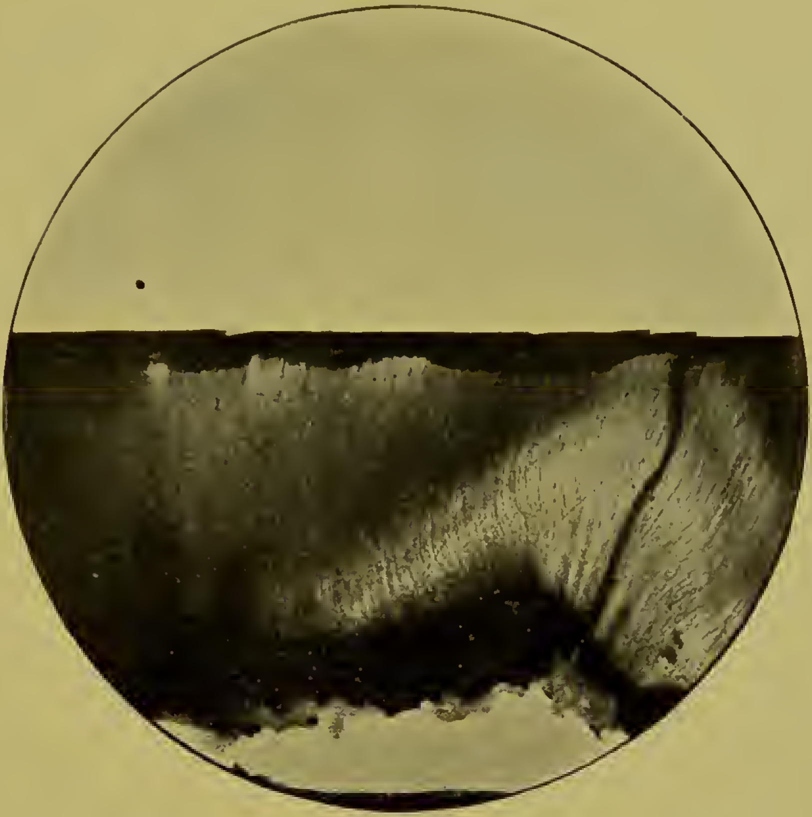
Decalcification retarded by transparent dentin (at *a*).

FIG. 49.



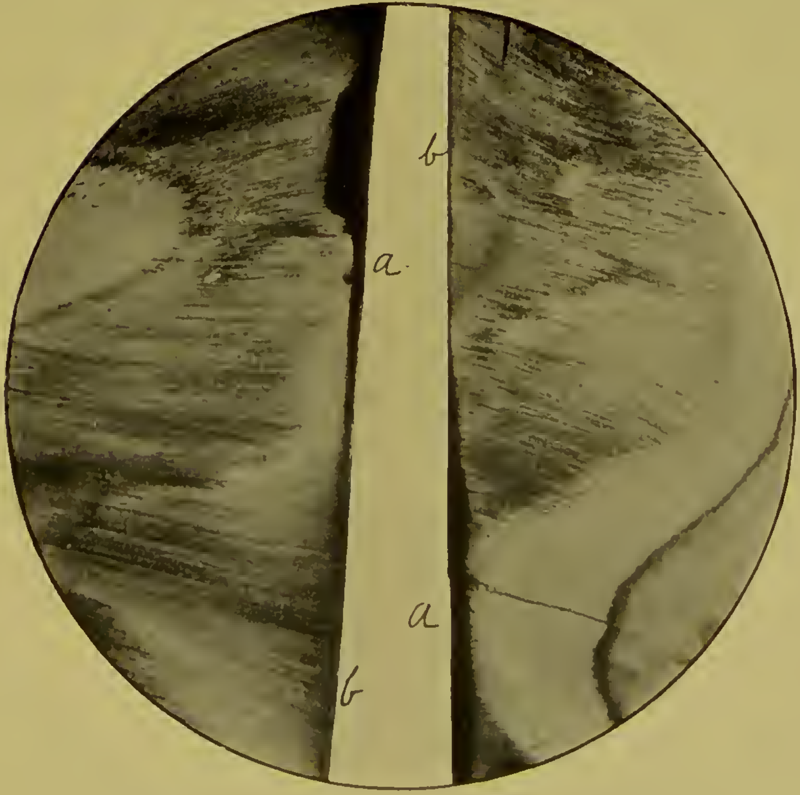
Decalcification retarded by transparent dentin (at *a*, *a*).

FIG. 50.



Striking influence of transparent dentin on process of decalcification.

FIG. 51.



Immunity of self-healed dentin to action of acid (at *b*, *b*).

down from the morsal surface until comparatively normal dentin was reached at *a,* while the parts at *b* were still strongly pigmented. These teeth were suspended in solution No. 1. Sections ground after four days revealed the striking fact that the pigmented dentin, especially in the right piece, had scarcely been affected at all by the acid.

We have here a phenomenon which recalls the similar comparative immunity of decay marks on the enamel to the action of acids. It accords with the observation which I have repeatedly made, that self-healed dentin is but slowly affected by acids.

In view of these results I must conclude that the vitality of the tooth as expressed in the production of secondary and of transparent dentin is a factor not to be neglected in our attempts to account for all of the phenomena observed in connection with decay of the teeth. Whether the vitality of the tooth offers any obstruction to the advance of decay over and above that manifested through the agency of secondary and transparent dentin is a problem still to be solved at the expense of much patience and labor.

Evidently certain changes of a nature still to be determined take place in the dentin which make it to a certain extent impermeable by acids. This fact, as well as the fact noted above that decay marks likewise offer an increased resistance to the action of acids, throws out suggestions which we ought to be able to make use of in the prophylactic treatment of the teeth. Undoubtedly there are substances which applied to the teeth would help to bring about or intensify the above changes, and it remains to determine if possible what these substances are. At present only silver nitrate has been employed for this purpose, and with a certain degree of success.

The results of the investigations which have been reported upon above show us that there are many influences operating upon the teeth in the mouth, some of which are detrimental to them in a very high degree, others but slightly, while some, finally, have even a protective action which may vary under different conditions. The total action of all these influences will depend upon how many and which of them are acting together, and upon the resistance offered by the teeth acted upon. This resistance, again, depends to a certain extent upon the structure of the tooth, upon the perfection of its external enamel crust, the enamel cuticle, and upon its freedom from fissures, bruises, cracks, or weak lines such as are produced by uncalcified prisms. The resistance may be modified to a more or less pronounced degree by a process partly of a physical or chemical and partly of a vital nature which takes place in the tooth itself.

Discussion.

The CHAIRMAN. Ladies and gentlemen, you have heard this magnificent paper, and I really feel that I might repeat my eulogistic remarks on Professor Miller in introducing to you the gentleman who will open the discussion of the paper, Dr. Black of Chicago.

Dr. G. V. BLACK, Chicago, Ill. Mr. Chairman, ladies and gentlemen: I wish first to congratulate Dr. Miller on the fact that he has the health and strength and vigor to go through the amount of experimentation which must have been necessary for him in order to present this paper. It is only by such careful, painstaking, and continuous labor that the facts for which we are searching can be developed. Personally, I wish to thank Dr. Miller for the work he has now presented to us.

To undertake the detailed discussion of such a paper is practically impossible at this time. Such a discussion would require me to have carefully studied the paper, and thought over the various points and compared them with my own work and that of others, before presenting a detailed criticism of its several points. I know, however, that the points made are valuable to science, and will have their influence in the future in the formation of the ideas of the dental profession.

I would have liked very much to have a few of the specimens thrown on the screen again, but perhaps I can recall them to your memory to enforce one or two ideas I wish to suggest. I refer particularly to the specimens showing the undermining of the enamel by decay. The acid has obtained access to the dentin through a fissure or where lodgments of food have occurred, and it has burrowed more rapidly in the dentin than in the enamel, and the decay of enamel has been from the inside outward.

We have in this an exhibition of the results of confinement of the acid and its action upon the various tissues while upon the adjacent surfaces there is no action of an acid. This should create the impression at once that the confinement of an acid upon the surface of a tooth will produce in this confined space a pronounced phenomenon of caries.

In regard to plaques. Taking the expression of the plaque as given by Dr. Williams, Dr. Miller is correct. I have seen teeth of immunes covered with filth, and the expression "plaque," as used today by Dr. Miller, is nothing more than this. Masses of micro-organisms may be growing in a greasy mass on the tooth for years together, and yet produce no decay. That mouth is immune.

This is not the plaque that I have mentioned, and I am convinced that Dr. Miller has never seen this plaque. I hope he will find it. It is a transparent mass; so transparent that when the teeth are apparently cleaned the plaque remains. I have seen some of it in the pictures shown today. You will not discover with the eye that there is a plaque, it is so transparent. But if you will pull it off carefully, you will have a plaque with only a slight yellowish tinge, and this is the only plaque that I have spoken of as having an influence in the beginnings of caries. It is not found generally, but only in those mouths in which decay is progressing rapidly. I have grown this plaque artificially and have seen it in large masses. And I am sure that under certain dietetic conditions it is produced. Until Dr. Miller has seen and examined it for himself, I do not expect that he will speak otherwise than he has done today.

Why is caries localized upon certain points on the tooth? First, because of the opportunity for the lodgment in pits, fissures, and grooves; the opportunity for the confinement of the products of acid formation at certain points, as upon occlusal surfaces and approximal surfaces, making a narrow space in which the tooth is not clean. Ninety-nine per cent. of the decay which we meet occurs on buccal surfaces near the gum. The accidental cases occurring at other parts merely prove the general rule. Now, why this localization? I wish to bring the question prominently before you.

Teeth rarely decay except in these unclean regions and where the acids produced may be confined to the locality. In other words, the saliva never becomes so acid as to produce decay. Decay occurs only when it is confined in this manner.

In immune persons I have twice unwittingly made experiments by cementing on bands and leaving them too long. Either through the cement not being well placed in the beginning or having dissolved out, micro-organisms growing under it caused a ring of decay nearly as broad as the bands, no other decay occurring anywhere in the mouth. We shall have to account for the confinement of the acids in these localities before we have all the phenomena of decay in our minds.

I should not say that there could be no decay without bacterial plaques, because we can produce it in mouths believed to be immune. But it occurs because of the confinement of the acid in a particular locality. What may be the surroundings in the other cases we do not know, and if such workers as Miller, Michaels, and others who are attacking this problem can give us the information, they will do well. And let me say that these scientific questions are those upon which our operations must be based. They are the practical questions of the future—questions of the utmost importance to us and to our patients.

I wish to thank Dr. Miller for his observations upon the enamel cuticle, which are practically very important, if what he has said is correct; and, reviewing hastily my own observations upon the enamel cuticle, I feel certain that he is correct, although I had not placed it in the light in which he has placed it today. We have lessened the resistance of the teeth to decay by removing the enamel cuticle. That is a point of considerable importance.

The question of the calcium salts is important; it is one that should be brought before us prominently and correctly by the chemist. My own experimental work had reference to the calcium salts and to the hardness and softness of the teeth as shown by those salts. As the result of my own work I have made the remark that there seems to be something of the strength of the tooth due to the condition of the basic substances, aside from the amount of calcium salts. What may be discovered in that particular direction I do not know. Dr. Miller's work, so far, does not bring that to the front. I have wondered if chemists cannot give us the proportion of calcium carbonate and phosphate in tooth-structure—those salts that are more easily dissolved, and those that are dissolved with more difficulty. There is a problem there to be worked out. I do not regard as yet the differences in solution of different teeth as being sufficient to account for the differences in caries of different teeth, or in the teeth of different persons—not by any means. It is certainly the case that secondary deposits are not acted upon as quickly as is normal dentin; if the secondary deposit be full of interglobular spaces it decays more quickly than normal dentin. Most secondary dentin is comparatively without dentinal tubules; and all these things come into play. It is possible that the dentinal tubules in the hyaline zone may be filled more or less with the fat which gives prominence to them as clear spaces, and for this reason they are not penetrated as rapidly by acids as are other regions. I throw that out as a probability; it is a question that has been in my mind for observation and study during the last twenty years.

The question of diathesis is of great importance in this connection. It is not a question whether micro-organisms grow in this mouth and that mouth. I have cultivated them many years with this question in my mind. I have yet to see the human mouth in which they were not growing, and I think Dr. Miller will say the same. They are growing in the mouth of everyone, whether decay be present or not. There is something in the diathesis which gives this power to produce decay to some varieties, and which robs them of it in others, and we must continue our search until we find the causes of this. We have not found it yet; we have not explained it yet; and until we have explained it in scientific terms we have not finished our work in this direction. I suppose there are few people who will question the fact of the bacteriological cause of decay as developed by Dr. Miller twenty years ago. And I think we should do well to thank Dr. Miller for that development now with a rising vote.

The assembly accordingly expressed its appreciation of Dr. Miller's work by a rising vote of thanks.

Dr. JAMES TRUMAN, Philadelphia, Pa. When I rise to consider any subject of this character I sometimes prefer to be in opposition to the one opening the discussion and not to the facts as presented in the paper. When Professor Miller comes before us, I feel sure that he will go down to the foundation of things and give us facts as to which there can be no dispute.

I have been much interested in this paper for a number of reasons. First, that he has demonstrated that the so-called gelatinous plaques of Williams are not productive of caries. I feel that the illustrations given on the screen have fully upset that theory. I cannot understand, therefore, Dr. Black's statement that Professor Miller has not reproduced the plaques as he (Dr. Black) has seen them. It seems to me that if Dr. Black is so sure that the plaques, as he has understood them, have not been represented on the screen, it becomes his duty to demonstrate to the profession that he has seen something else. I may, however, have misunderstood him.

Dr. Black repeats the suggestion made by Wedl thirty-four years ago, that the transparent zone of Tomes is the result of infiltration of fat globules in the tubuli. This has never been proved, and further, is not sustained by the fact of the development of secondary dentin where slight irritation invariably produces an increased deposition and further development of this tissue. The same law operates in the one case as the other. It is very evident that this transparent zone is the result, not of fat globules, but of an increasing deposit of calcium in all respects similar to the so-called senile dentin, where the tubulated structure is frequently entirely lost.

I was also pleased with the demonstration that proved that silver nitrate had no deterrent effect in preventing caries. Silver nitrate has a valuable place in the therapeutics of dentistry, but it cannot be used as a mouth-wash, as has been recommended in certain quarters; and this clinical observation is sustained by Professor Miller's work. It is probable that this, as represented today, will cause a revolution in thought in our profession, leading to more care in the use of this agent and to a more intelligent appreciation of its effect upon the tissues of the teeth.

I trust that those present, in listening to this paper, are prepared to indorse the action of the Committee on Prize Essays in conferring the highest honor on Professor Miller.

Dr. E. S. Talbot, Chicago, Ill. I wish to congratulate Dr. Miller upon his excellent paper and his work. His slides brought out fully the work which he has accomplished. It would be strange, however, if in viewing this subject we did not differ. I am sure that Dr. Miller would feel hurt were we merely to pat him on the back and say that he had given a magnificent paper. The criticisms of Drs. Black and Truman throw a different light upon some of the points under discussion. Tooth-decay demands study from a broader standpoint. Conditions around the teeth are not all the causes of decay. What has been said demonstrates conclusively that, as I have elsewhere pointed out, other conditions must be taken into consideration. In the evolution of man teeth are growing smaller and degenerating in type, whence the change of shape. This suppressive economy of growth has as much to do with the decay as anything else.

Dr. Black asked why the decay is circumscribed, and he here brought out a point which no one will deny.

In the development of the teeth, degeneration takes place in the enamel as well as in the dentin. Not a slide put upon the screen failed to show degeneration in structure. The fissures shown where the plaques extend down into the dentin indicate malformed teeth, and this malformation is a phase of evolution and embryogeny.

To the balancing power of the nervous system must we look for healthy composition of the teeth and other structures, and to the underlying law of economy of growth—since every part of dental pathology has a developmental basis. If a mother be not nourished, or if from worry her tissues fail of proper development through lack of nutriment to be carried to the particular part, the fetus cannot be well developed, and suppressive degeneracy must occur.

Dr. Black discussed accurately the difference in structure. A patient comes to have his teeth put into a healthy condition. He is afterward taken with typhoid fever, pneumonia, or other constitutional disease, whereby his system becomes poorly nourished. Let him then return to his dentist, and a difference in structure and discoloration of the teeth are found. Following the death of a relative of mine, his wife in six months had a change in the structure and color of her teeth. I have tabulated many such cases. In grief or worry from any cause the structure of the teeth will change, and decay will take place. Fill the teeth of a young lady going to a boarding school; let her return in the spring, and not only new cavities but decay are found around the margins of those filled. Some dentists may claim that the fillings were poor, but this has been repeatedly disproved. The decay is caused by the extra amount of work; the nervous system is overstrained, and this change has resulted. The balancing power of our nervous system has much to do with the decay of the teeth—probably more than anything. The diathesis is likewise important.

Dr. G. W. Cook, Chicago, Ill. I have not only been interested in Dr. Miller's paper today, but in his work from my first recollections of dentistry. There are several points of this paper which might be discussed with considerable benefit, but time will not permit of details. Dr. Talbot has brought out the point in regard to the changes of the physiological activity of the human being as a factor in the production of soft teeth. I do not believe that the structures of the tooth have changed so much as have the fluids of the mouth and consequently the activity of the organisms in the oral cavity. I think that that is one of the main factors.

While we can appreciate the development of the tooth-structure, still there are changes in the life-processes of the individual that must change all the fluids of the human body. Take diphtheria: an individual may be immune to the action of the Klebs-Loeffler bacillus, yet tomorrow there may be susceptibility to it. Why? Today the bacillus may be in the oral cavity without detrimental action, but the fluids of the cavity change and call up the virulence of the organisms and lower the vitality of the mucous surfaces. The teeth do not change as does the pathological structure of the mucous surface, but the secretions change. We know there is a change, for one day we can find perceptible traces of the conjugated sulfates, while the next day they have entirely disappeared. The change in the culture medium of the organism may be caused by the nervous system or some other function of the body. But I do not believe that the teeth change.

From some work that I have done I am convinced that the organisms that live in the oral cavity are undergoing various physiological changes, and that they change the quantity of acid or other toxic conditions that are present in the mouth.

Dr. Miller has the honor of having placed this subject on the firmest foundation of any pathological condition occurring in the human race. To him is due the honor of laying the foundation that we can at least work upon. (Applause.)

Dr. C. N. JOHNSON, Chicago, Ill. It would give me a great deal of pleasure to take part in this discussion from a scientific point of view. But I think we shall be able to do that better when we have the paper printed and it is before us for careful reading in full. I want to thank Dr. Miller for his contribution to this congress, and to tell him how much we appreciate his coming here. I think the size of the audience will indicate that. And we are also proud of the fact that, as Dr. Cook has said, he has placed this question upon the most scientific basis of any question in connection with dentistry.

Dr. Johnson then announced that some interesting slides illustrative of the work and methods of the eighteenth-century dentist, Pierre Fauchard, would be shown immediately after the close of the discussion on Dr. Miller's paper.

The CHAIRMAN. I can only second this proposition as chairman of Section II. We owe it to ourselves as a matter of instruction, and to the author of the paper as a matter of courtesy, to see these pictures. I hope the audience will remain for that purpose after the close of Dr. Miller's remarks.

Dr. MILLER (closing the discussion). I wish to thank the gentlemen who so kindly discussed the paper. I have only to say to Dr. Black that my strictures on the plaque do not apply to his plaque—if, as he says, I do not know what his plaque is. But, if I am able, I shall certainly make a pilgrimage to him in Chicago for the purpose of making its acquaintance—and I do not know anyone more worthy to be the object of a pilgrimage than Dr. Black.

I also agree with him in what he says with regard to the necessity of confinement of the acid. But it is confined sufficiently in the fissures and cavities of decay and between the teeth where the food lodges. Examine any case you like, and you will find starchy foods between the teeth to have a strong acid reaction. What more do you want?

I do not agree with him as to the transparent zone. I have not found fat in it. It does not occur in dead teeth. It is a sclerosis of the dental fibrils, a diminution of the caliber of the tubules by the production of dentin on their periphery. It is a consolidation of the dentin, and the acid does not penetrate such dentin as rapidly as it would the normal dentin. Dr. Truman has made that point clear.

As for the chemical composition of the dentin, I have repeatedly pointed out that it is not by any means simply a question of the percentage of calcium carbonate or phosphate, but of the combinations formed by these substances with the organic matrix. On this point our knowledge is at present totally deficient.

Dr. Talbot remarks that I have not considered the constitutional side of this question, but I would remind him that I have been able to present at this time only about one-half of my paper. I understand also that the lines to which he refers in the enamel are defective structures. They are not, however, degenerations, they are faulty development. They are uncalcified enamel prisms.

I doubt, as I have stated before, whether a degeneration of a tooth can take place after it has once become fully developed. I do not believe it has been proved that a hard tooth can become soft. If Dr. Talbot has preparations to demonstrate that, I shall be very glad to see them. In the case of the school-girl, I think the decay can be explained. In the first place she does not clean her teeth, and secondly, she is constantly eating chocolate.

Discoloration is not necessarily a sign of degeneration, because we know our dead teeth discolor often enough. It is a chemical process, and may be independent of vital changes in the tooth.

I wish to thank Drs. Truman and Peck, also, for their courteous treatment of my paper, but I beg to be excused from continuing the discussion, as I am suffering considerable discomfort from the prolonged speaking. I thank you all very heartily for your patient attention to my long paper, and hope on some other occasion to meet you under more favorable circumstances.

The CHAIRMAN. I again rise to thank Dr. Johnson for the use of this room, to thank the audience for their close attention, and Dr. Miller for his magnificent paper.

Dr. G. V. BLACK, Chicago, Ill. I wish to make a motion. Twenty years ago and more, Dr. Miller first demonstrated to the dental profession the bacterial origin of dental caries. In the twenty years that have elapsed since the first publication of his articles the correctness and the great value of his work have been more and more impressed upon the minds of men. It seems to me fitting now in Dr. Miller's presence that we, in congress assembled, should express this fact to Dr. Miller, and give him assurance of our most hearty appreciation and thanks for that work. I move that this be embodied in a resolution, as follows, and that we pass it now by a rising vote:

RESOLVED, That the dental profession, in the Fourth International Dental Congress assembled, wishes to express its gratitude to Dr. W. D. Miller of Berlin for the noble work done by him twenty years ago in developing the facts of the direct relation of bacteria to the causation of caries of the teeth, the truth of which has stood the test of many and repeated corroborative experiments by others, and year by year has come to stand out more and more brilliantly as a great scientific achievement of lasting good to humanity.

The CHAIRMAN. Gentlemen, you have heard this motion, which is duly seconded. I beg you all to rise.

The motion was unanimously agreed to.

A paper by Dr. T. FUJISHIMA, Tokio, Japan, entitled "A Case of Odontome," was then read by Dr. M. L. Rhein, as follows:

A Case of Odontome.

By Dr. T. FUJISHIMA, Tokio, Japan.

I FEEL it to be a great honor to be permitted to make a report of my experience in this great meeting.

In September 1896, I inspected a patient by his request. He was thirty-two years of age, stout and strong, and his teeth were all in splendid condition, not a single decayed tooth being found. His complaint was that he had had frequent temporary pain in the region of the lower left third molar, from about a year ago, this afterward leading to toothache of the whole of that side with hemifacial pain. The pain was not continuous, and he did not have much anxiety about the case, as he believed that the pain was due to the growth of the third molar, and would end at its eruption. But the pain increased with time, and sometimes his body temperature was brought up to 40° C.

One of the physicians diagnosed the case to be due to the developing third molar, and the part was cut. Yet no relief was obtained; the pain remained as it was. Another operation was made, but again without success. The physician then brought the case to me. On very careful inspection, no trouble was found at all, except that in the third molar region, closely back of the second molar, something like a tooth was felt beneath the gum. It being my belief that this was to be accounted for by the third molar in its growth leaning forward, a cross cut was given to that portion of the gum, and it was pressed hard with a cotton ball. On inspection of the fissure after cessation of the bleeding, what had been supposed to be a third molar was found to be a protuberance on the second molar, and at the same time a small hole was found at its back surface. Cocain was injected, and the tooth was extracted. It was discovered that the specimen was an odontome of the root. After extraction there was no particular trouble in effecting a cure, except that the fissure took somewhat longer than usual to recover.

After a lapse of seven years—or in October 1902—I found another odontome on the third molar of the same patient. Only a small portion was visible, and it looked like caries of the jaw. Extraction of the same was suggested, but the patient did not accede to it from fear of pain. He did not come to me thereafter, and when I called on him the following March, a painful cavity was found at the front corner of the jaw, and blood was running out. The odontome, at the same time, was exposed beyond the gum to an enormous area. I made an impression for a specimen, and this was taken out afterward. The wound was treated by a surgeon, and recovered in a short time without difficulty.

I wish to classify this case according to Dr. Bland Sutton's theory, who defined odontome as follows: "Odontomes are neoplasms composed of dental tissues in various proportions and different degrees, or teeth still in the process of growth."

Odontome number one must have resulted from aberration at the back of the tooth, which in process of its growth had just completed the formation of its crown and started the formation of its root. A part of the papilla inside must have suffered some interruption of development. The imperfect formation of the crown of the tooth naturally caused imperfect development in the process of enamel organization. The cavity on the enlarged root was the result of pathological phenomena due to a lack of normal vital resistance of the tissues which formed the odontome.

Odontome number two resulted from abnormal growth by aberration of all the elements of the tooth-germ—enamel organ, papilla, and follicle—caused by irritation on the whole tooth-germ.

Discussion.

Dr. G. W. Cook, Chicago, Ill. I do not see that there is any particular comment to make on this case. It is a perverted activity of the enamel cells placed in some obscure part of the alveolar border. It may form at the buccal side of the root, but as odontomes are ordinarily found there may be a great number of enamel portions lodged in the jaw—epithelial cells wandering away and depositing enamel or some other hard tissue. In one case I know of there were seventy-two of these small enamel tumors in the jaw below the alveolus.

This subject cannot be discussed at length without a familiarity with the case we are discussing, and I do not think that a general discussion of the subject would be of great value to the section at this time.

The Chairman announced that the section would meet next day at 2 P.M.

A motion to adjourn was made and carried.

SECTION II—Continued.

FOURTH DAY—Thursday, September 1st.

THE meeting having been called to order,

Dr. W. D. MILLER, Berlin, Germany, in presenting, in the absence of the essayist, a summary of the paper submitted by Dr. F. Vicentini, Chieti, Italy, on "Leptothrix Racemosa" [for paper printed in full see page 293], said: I suppose most of those present are acquainted with a work brought out by Dr. Vicentini some years ago, in which he dealt with a micro-organism discovered by him in the human mouth. This micro-organism he named *Leptothrix racemosa,* and regarded it as the parent plant of the great majority of the forms of micro-organisms found in the mouth. This present essay is in part a review of the different criticisms upon the work just referred to, and it would therefore be impossible to give a *résumé* of this part of the paper.

In the second part of the paper he deals with caries of the teeth. He says he does not feel competent to treat of this subject, and I do not think that this part of his work has come up to the standard of his other investigations. His views on this subject tend to reduce the importance of external agents. He concludes by referring to the view of Dr. Eben M. Flagg that caries is an eruptive disease proceeding from the inner to the external part of the tooth. His own views, he says, are in some respects not much at variance with those of Dr. Flagg. In this point of course I must disagree with him.

Dr. E. C. KIRK, Philadelphia, Pa. I should be very glad to have Dr. Miller express his own view on the position taken by the essayist in regard to the importance of this organism, leptothrix racemosa. As I understand it, he claims that it is the parent organism of a large number of the bacteria that occur in the mouth, and that the various coccic forms and rod forms are merely the fragmentary parts resulting from the breaking down of the sporulation heads and stems of this rather large organism.

I have followed Vicentini's methods and have been able to find in the secretions of my own mouth specimens of the leptothrix racemosa. It is certainly a very interesting organism, although I have examined it only in a rough way.

It does seem to me that the contention Vicentini makes should have a respectful hearing. Not being sufficiently well acquainted with the biological evolution of these forms I should be glad to hear from Dr. Miller on this point. I understand that such organisms as the micrococcus of sputum septicæmia are claimed by Vicentini to originate from it?

Dr. Miller. Vicentini considers the various coccic and rod forms as parts in the cycle of development of leptothrix racemosa. You can see the central thread only in parts where the micrococci are not so numerous, and Vicentini claims they are connected with the same by a little thorn and are developed from it. Formerly we thought they were nothing but leptothrix threads about which micrococci had accumulated. But according to his ideas they are organically connected. Sometimes they may be seen to grow out into long threads, so that we have the cycle of development of different forms.

I believe that Vicentini claims that nearly all the forms of organisms found in the mouth may be looked upon as coming from leptothrix racemosa. Personally I am not convinced that such is the case. It seems more likely, and our cultural investigations in bacteriology point to this conclusion, that there are varieties of bacteria in the mouth which may be different stages in the development of leptothrix racemosa.

Dr. L. D. Hurst, Denver, Colo. You accept then the position of Vicentini that the round coccal forms are in organic connection with the stem, and that it is not simply chemiotaxis?

Dr. Miller. I have not seen it myself.

Dr. Hurst. Would not the evolution of the process indicate that there was a vital connection?

Dr. Miller. Yes, there may be, but as I stated, I have never seen thorns connecting the micrococci with the stem so distinctly as to be absolutely sure of it. Others claim to have seen them very clearly.

Dr. Hurst. If it were purely chemiotaxis, how could you account for the grouping on one end of the stem?

Dr. Miller. The growing portion of the stem is more active, as it is for example in yeast fungus. But, mind you, I do not look upon these appearances as a result of chemiotaxis. We have undoubtedly a wonderful and most important organism in leptothrix racemosa, but its life-history is far from being cleared up.

Dr. M. L. Rhein, New York, N. Y. With regard to a practical application of the subject you presented to us yesterday, that is, the deposit of plaques on two surfaces acting as a preventive of dental caries, do you include, in that, teeth that are comparatively clean and free from plaques and still show the microscopic deposition of a plaque of leptothrix racemosa? Williams' deductions on that subject have gone very far to give this organism an importance in the plaque stage. Do you make any differentiation in a plaque of this particular kind on comparatively clean teeth?

Dr. Miller. I do not make any distinction of that kind, and I was not aware that the leptothrix racemosa takes any more prominent part in the formation of the plaque than other micro-organisms. It is a point, however, which I have not particularly looked into.

Dr. G. W. Cook, Chicago, Ill. I was going to ask Dr. Miller if he had noticed that cocci were sometimes formed at the end of the thread.

Dr. Miller. Of the secondary thread?

Dr. Cook. Yes, I find in some cases that a bulbous thread is given off, while in another it will run off without any cocci at the end.

The paper in full as presented by Dr. F. Vicentini here follows:

On the Botanical Diagnosis of "Leptothrix Racemosa" and its Asserted Relation to Dental Caries.

By Dr. F. VICENTINI, Chieti, Italy.

In thanking the committee for the hospitality kindly granted to the present paper, for the sake of clearness and for the better understanding of the whole subject, I venture preliminarily to call the attention of the reader both to my work on "Bacteria of the Sputa and Cryptogamic Flora of the mouth" and to my subsequent articles on the same subject, published in the *Dental Cosmos* from 1900 to 1903, and in the *Vierteljahrsschr. f. Zahnheilk.* for 1903.

An abstract of the Italian edition of my work was published in 1893 in the *Comptes rendus* of the Société de Biologie of Paris (pp. 838-841). After the English translation of the same work, published in 1897, Mr. Mummery read on the subject a communication, accompanied by lantern slides, before the Third International Dental Congress, held in Paris in 1900. But, owing perhaps to the heterodoxy of my views, my work remained almost completely ignored in France until Professor Frey and Mons. Lemerle presented in August 1902, before l'Association Française pour l'Avancement des Sciences a communication entitled "Les Leptothrix de la bouche, aperçu microbiologique: leur rôle dans l'étiologie de la carie dentaire: Leptothrix racemosa." But I was not aware of this communication until last May (1903) by a translation published in the *Quarterly Circular* of Ash & Sons. By the kind favor of Professor Frey I received as well the French text, but here I refer only to the said *Quarterly*.

It might be regretted that the authors have not undertaken personal researches on the subject. This notwithstanding, I will respectfully rectify some of their statements, also answering some of their queries. I meantime thank the authors for their indulgent appreciation of my work, though I am in duty bound to observe that I am not a "savant," but a simple private practitioner. How I was led to undertake the above work, through my numberless examinations of sputa for clinical purposes, has been already pointed out by me in the before-mentioned work, and lately in my "Reply to Professor Arkövy." (See *Vierteljahrsschr. f. Zahnheilk.*, 1903, pp. 198-201.)

The standpoint from which the new organism was looked upon by the authors appears sufficiently determined by the title of the paper and by their principal statement, *i.e.* the "decalcifying action" on the enamel, for which, in their opinion, the new organism would present the greatest interest to the students of oral bacteriology. (*Quarterly Circular*, March 1903, pp. 44-45.)

What ground there may be for this statement we shall see later. For the moment I dare observe that the capital fact "of the luxuriant vegetation of racemosa upon all the sound teeth," which was repeatedly emphasized by Dr. Williams, by other observers, and by myself, would seem to indicate that, neither by chance nor for engendering disease, has this organism been lodged on such a wide scale, and with such a deep tenacity and striking complexity of forms, in the human mouth.

Deus et natura nil frustra moliuntur. It was, I believe, in agreement with this aphorism of Aristotle that, toward the end of his above-quoted communication, Mr. Mummery was led to state that "In future no student of the flora of the mouth can afford to ignore this organism, as its great abundance would seem to indicate that it must bear some very important rôle in the human economy, and that whatever deductions may be made from Dr. Vicentini's discovery, it is certainly a very interesting one to the bacteriologist, for we have growing in the greatest profusion in every mouth an organism which appears to be on a much higher scale in the vegetable kingdom than the small elements, filaments, cocci, and bacilli to which our attention has almost exclusively been directed."

The prominent and very excluding character of racemosa in the mouth was lately summed up in the following terms at the end of my said "Reply to Professor Arkövy": "Only I dare regret that Professor Arkövy, though so explicitly recognizing our racemosa as a parent organism of various minute bacterial elements, seems to have entirely overlooked a consideration of prime interest, which had been repeatedly emphasized by Dr. Williams and by myself, *i.e.* the "luxuriant vegetation" of this parent organism, which (besides the matrix, the lower stumps, and the male organs) thrives by more than one trillion six hundred billions of stems and fruitful heads upon all the sound teeth, each stem containing a number of reserve-gemmules, apt to become as many inclosed bacteria, and each fruitful head bearing hundreds of sporules. It is precisely against this most important fact, as against a firm rock, that most of the objections and difficulties advanced by our critics are likely to be wrecked, inasmuch as the new organism—as I said in my second reply to Mr. Goadby, *Dental Cosmos* for 1902, p. 677—"cannot be merely considered as a fortuitous inhabitant of the buccal cavity, but deserves undoubtedly the greatest attention as being the most complex, the most prominent and indestructible organism (the organism *par excellence*) of the human mouth, and one which has not yet been found in its full growth elsewhere, neither in the external world nor upon some other part of the body." (*Vierteljahrsschr. f. Zahnheilk., loc. cit.* pp. 219, 220.)

Now, on this subject I have often asked myself whether both the dissevered bacterial elements, thriving in the digestive, genito-uninary, and air passages, and the racemosa tufts growing over the teeth, might not play some beneficent rôle in the human economy.

When we consider, indeed, the rudimentary forms, thriving in a dissevered and wandering condition over the natural openings of the body, we cannot forbear from thinking that these forms may have been overspread there, like an inexhaustible preserve, for the recruit of as many hordes of scavengers or necrophagous agents, destined both in health and in disease to migrate and multiply everywhere, at the expense either of the decayed cells and corpuscles or of the corrupt material to be removed from the living economy. In an apposite paragraph (pages 203 to 216 of the English edition of my work) I have already supplied evidence of this statement, but I will recall here only two of the more obvious facts there alleged. And the first is the daily occurrence (in so many refuse or morbid products submitted to microscopical examination) of epithelial cells, of white blood corpuscles, of pus corpuscles, etc., which, soon after their decay, appear more or less filled with bacteria, until they become converted into as many zoögleic masses, still keeping respectively the orginal size and shape of each defunct cell or corpuscle; the second, the fact of such crowded swarms of common bacteria, which may be seen daily thriving in all corrupted matters, and which may be met with, so well intermingled with the so-called pathogenic ones—within this or that morbid seat or product—that the latter forms appear to have thriven there together with the former, and the legions of the said common forms to outnumber often the clods of the asserted pathogenic bacteria to such a degree as to make their "ubiquity" quite evident to any unprejudiced mind. I shall allege later, under the heading of "dental caries," other facts in support of this view.

As to the criticism of Professor Arkövy, I am pleased to thank him in this note for his frank sincerity, and for the justice done to my remarks, in a short *entgegnung* appended by him to my reply, and from which it will suffice to reproduce here simply the first paragraph: "Herr Dr. Vicentini hat sich im vorstehenden Aufsatze viel Mühe gegeben, seinen Standpunkt in der Leptothrix-Frage klar zu legen, und die von mir begangenen Missverständnisse richtig zu stellen. Für jene ist es das Fach, für diese ist es meine Person, die ihm däfur dankbar sind." (*Vierteljahrsschr. f. Zahnheilk., loc. cit.* pp. 220, 221.)

The full and fixed growth of racemosa appears, in its turn, to have been lodged over the teeth (where special conditions seem to have been provided for a higher and before unknown development of bacterial life), in order to "enforce the vitality of the species" by means of a true "fructification process," thoroughly different from the simple "fissiparous multiplication" before acknowledged, in the dissevered bacterial elements, by the previous observers. By considering, indeed, the multiplication of these micro-organisms, and that of the cryptogams in general in comparison with the multiplication of the phanerogams, at page 182 of my work, I recalled the well-known fact that the simple "multiplication or transplantation" of the phanerogams by means of bulbs, tubers, shoots, or buds, differs substantially from their genuine "reproduction process" by means of seeds. With transplantation, in effect, are transmitted the accidental modifications brought about by domestication, grafting, etc., which in the long run may end in the degeneration of the plant; whilst with seeds, on the contrary, the species reverts to the natural vigor of the wild state. Now, we may incline to believe that something similar may happen even with cryptogams. Probably in those which have, besides a fissiparous multiplication, a true reproduction through spores, the sporulation will mean that the species resumes its native vigor in spite of the attacking or enfeebling causes which, as in our parasite, may impair its vigor.

Coming now to the single statements of Professor Frey and Mons. Lemerle, according to the same order which was followed by the authors, the first question we meet with in their paper is that of the oneness or plurality of the thread forms (the so-called leptothrical species) thriving in the mouth.

Both in my work and in my subsequent articles I have pointed out that these asserted species were assumed, by Professor Miller and other authors, on the ground of some accidental morphological features or staining phenomena, before the discovery of the new organism. But that at present all the said forms can be reasonably related to various phases of the stems of racemosa itself was repeatedly suggested by me, according to the synopsis given at page 99 of my work. There, in effect, I was led to consider *Leptothrix innominata* as tufts either of still unripe filaments of racemosa, or of its matured stems despoiled of their sporules and pedicles, or even of its recently truncated stalks having not yet undergone that increase in size and that inward development of inclosed bacteria within the sheaths which in my opinion would give rise to their final transformation into *B. buccalis maximus,* and so on. The thickness as well as the woody state of a great number of these truncated stalks, with deep violet reaction under iodin, would depend, as I suggested, upon a very natural cause. The rupture, indeed, by removing the apex, *i.e.* the fruitful point of the respective filament, renders the remaining portion of the same unable to attain its truly reproductive stage. Then the truncated stalk retrogrades to the lower function of a merely vegetative organ, by its increasing in thickness and the inward formation of inclosed bacteria, at the expense of the pre-existing reserve gemmules (drawn in my Figs. 2, n^1, 16, a^1, and 24), through some retrocession of the ascending sap, as happens, for instance, in the pruning of trees. It is precisely this disintegration of these old stalks that would constitute the "dissociated state," not only of our new organism, but even of other bacteria, as Cladothrix and allied species, constituting their "phase of dissemination."

Mr. Goadby came to explicitly agree with some of these statements, by saying that "Some of the thread forms described by Miller may be portions of the threads of racemosa," and that "It is extremely likely the Leptothrix racemosa was figured as one or other of these thread-forming bacteria" (L. buccalis maxima and L. innominata of Miller). (See Smale and Colyer, 1901, p. 214.)

It could be objected against this view that the relation above suggested between the said various filaments is still doubtful and uncertain, but notwithstanding this uncertainty—nay, because of the same uncertainty—the *onus probandi* as to the asserted plurality of the leptothrical species in the mouth must henceforward be mainly charged on our opponents; inasmuch as, by considering all the complex life-history of racemosa, the most probable presumption stands, on the coutrary, for the common descent of all the repeated thread forms from one common source.

Coming to the morphology of the new organism, the authors, at page 41, refer its first discovery to the year 1897, though this would be contradicted by what they add soon after—that in 1893 Mr. Mummery examined the new organism, following the indications furnished by me. To be exact, the first finding of racemosa (in a pulmonitic sputum) dates from March 1890, as related at pp. 125-128 of my work, while the first date as given by these authors would refer only to the English translation of the work, published seven years afterward.

The morphological sketch given by the authors appears sufficiently descriptive; nay, I was pleased to find there mentioned a particular which had been previously overlooked by other critics, namely, the "mass of gelatinous substance like a club, in the heart of which are ranged the spores in vertical and regular series." (*Loc. cit.*, p. 42.) Now this gelatinous substance is precisely what I called the involving glia or glair. But soon after, in dealing with the clarifying action of potash upon the said glia, when the specimen was stained with gentian violet, the authors come to infer that by this reagent (potash) are made out the transverse sterigmata, or pedicles of connection between the spores and the central stem; while this particular (overlooked likewise by other critics) refers only to those peculiar fruitful heads which show a club-shaped stem and a dual zone of colorization under gentian violet. There, in fact, the pedicles are otherwise invisible, while in all the common specimens the pedicles in question may be distinctly perceived, under a one-twenty-fifth inch homogeneous immersion lens, either by gentian violet or by the acidulated iodin solution, without the aid of potash. (See my second reply to Mr. Goadby, about the asserted artifact thread-like appearance of the said pedicles, *Dental Cosmos,* 1902, p. 675.)

Coming, then, to the real nature of the spore-like bodies growing upon these pedicles, the authors explicitly acknowledge that "The putting in evidence of the sterigmata observed by Vicentini does not warrant the idea of a simple accumulation of cocci"; but on the other hand they "cannot affirm that we are in the presence of spores, for it has not been possible to obtain the Leptothrix racemosa by the sowing of these spores." (Frey and Lemerle, *loc. cit.*, p. 42.)

Now, apart from the fact that, according to Dr. Williams, the germination of these spore bodies could begin even before they become detached from the parent stem (*Dental Cosmos,* 1899, p. 345), and that Mr. Goadby, in a hanging-drop preparation kept at 40° C., found short thread-like forms growing from some spore-like bodies of the fruitful head (*ibid.* 1900, p. 208), it must be observed that the difficulty of successfully sowing the said spore bodies upon artificial culture soils is not a satisfying proof against their germinative power. We shall see later that the fruitful stems of racemosa do not thrive immediately upon this or that culture soil, but only "upon the pre-existent matrix of the leptothrix growth," previously felted around the teeth, and thus racemosa, in its full development, has not yet been found, I repeat, neither in the external world nor upon some other part of the body.

At page 43, these authors, in dealing with the polymorphism of racemosa, say: "This organism, in fact, assumes in the course of its evolutionary cycle successive forms, without losing on this account its individuality. But Vicentini declares that these passing forms may under certain conditions become definitive. From this fact he concludes, for example, that spirilla are only portions of Leptothrix racemosa undulated or even regularly spiraled. The production of bodies in short or elongated rods, straight or comma, or of rounded bodies and of cocci, are only produced, according to him, from segmentation and divers formations of a mother species, the Leptothrix racemosa. There may be some truth in Vicentini's theory, but it is not possible at present, it seems to us, to share these ideas without reservations."

That the spirilla may spring directly from fragments of certain filaments has been already shown by De Bary in *Beggiatoa alba,* where conspicuous specimens of spirilla, possessed of flagella and capable of great activity, appear effectively to be set free from the said filaments. Dr. Billet, after Zopf and other observers, showed likewise analogous specimens of spirilla arising from filaments of Cladothrix and allied species. In racemosa, however, such a derivation from slender filaments hitherto undetermined was suggested by me only for the spirochæte (see the synopsis quoted above), while the spirilla, the comma, and virgulated bacilli were, on the contrary, designated as "male elements" fallen from the "male organs" drawn in my Fig. 14, *a, b, c,* and wandering in the mouth under the dissevered condition of comma, spindle-like, serpentine, and slender bacilli, endowed with great motility, and drawn in my Figs. 5, *f, g, h, h*¹, and 14, *d.* I dealt somewhat largely with these forms elsewhere, but I regret that no mention whatever of the same was made by these authors. The derivation of the spirilla, in the sense alluded to, from some undulated filaments they may have attributed to me from glancing perhaps at my Fig. 8, where are drawn indeed some so-called spirillic filaments, *Sp, Sp;* but it will suffice to observe that the drawing alluded to, taken from a paper of Professor Miller, represents nothing but a tuft of *Leptothrix gigantea* of a sheep. (See the explanation of the plates, at page 229 of my work.)

Far from admitting that either the passing forms of racemosa or the dissevered bacterial elements, thriving in refuse or morbid products or in artificial culture media, may, under certain conditions, become permanent, I only suggested that these dissevered forms appear to be destined to spread the respective species extensively, when they cannot do so intensively, *i.e.* by true fructification upon a firm and appropriate soil like (for the mouth bacteria) the surface of the teeth. But by no means could they cease from being, in such a dissevered condition, what they properly are, *i.e.* simple scattered particles, endowed only with a power of fissiparous multiplication, except when under favorable conditions they might initiate some further development toward higher forms. Evidently the authors cannot without difficulty free themselves entirely from that fundamental misconception of the modern doctrine of bacteriology by which the dissevered bacterial elements are dogmatically assumed today to be so many independent beings (see later).

In my previous articles, I pointed out also how many so-called pathogenic bacteria are now reasonably conjectured to be nothing but as many passing forms, either of streptothrix or of ray-fungus, or of some other complex organism. Now the artificial culture methods appear not only to interfere with any further and complex growth of the said scattered particles, but (by keeping as far as possible each separate type apart from all the others in so-called pure cultures) to work so that the dissevered condition tends to become a permanent one, in the sense that any eventual development toward the respective parent organism is, by this method, effectively precluded. This capital subject was touched on in my reply to Mr. Mummery's quoted communication, in the following terms: "It was because of the unnatural life conditions upon artificial soils and through artificial surroundings that for the last two decades the natural history of bacteria has been to some extent misunderstood, through a jumbling of experiments and assumptions which do not provide room enough for the right observation and understanding of the natural phases and behavior of these microscopic organisms." (*Dental Cosmos,* 1901, p. 859.)

But, that even in such a dissevered condition bacteria could, in "old cultures," be enabled to initiate at times some higher, though more or less incomplete, development toward a creeping, mycelial, or aerial-like state ("when their spreading phase becomes exhausted"), it was pointed out in my work, and more recently in my third reply to Mr. Goadby, in dealing with some ramification process noticed by various observers, not only in tubercle and in diphtheria bacilli, but even in pneumococci, in *Spirillum undula,* in *Vibrio rugula,* and other forms. (*Dental Cosmos,* 1903, pp. 705-707.)

As for the rest, I am gratified that Professor Frey and Mons. Lemerle, like other competent observers, at length acknowledge that "There may be some truth in Vicentini's theory." But, for the sake of brevity, I will come to the final queries with which the authors close their communication.

(A) "What place ought to be assigned to Leptothrix racemosa? Is it truly a leptothrix? Is it, then, a mucor? Without deciding in an absolute manner, it seems by its mode of reproduction (by sporangia) and its morphology (dense felting from whence are released the stems supporting the sporangia) that the racemosa approaches the mucors. The leptothricheans, on the contrary, are only simple filaments reproducing themselves by scissiparity or by simple sporulation." (Page 45.)

As to the latter remark, it will suffice to observe that the so-called simple "sporules," lodging within the leptothrical filaments, should be rather acknowledged as "gemmules of reserve" being developed into inclosed bacteria, when either the higher phase (the fructification) was precluded or the fruitful head was cut and taken away. Dr. Williams held, however, that the small bodies termed by me "reserve-gemmules" would represent instead "the commencement of the formation of a spore" (*Dental Cosmos,* 1899, p. 344), designating there by that term "spore" a true exogenous spore springing, in the sense suggested by me, from a respective pedicle. But against this statement it will suffice to oppose a simple consideration, *i.e.* that the reserve gemmules described by me may be perceived, not only within the younger threads, where they might at a first glance be assumed as future spores, but even within the matured stems, or portions of stems, already "spoiled of their sporules," as in my Fig. 16—a fact which I regret to have forgotten in my reply to Dr. Williams, inasmuch as it may plainly show that the small bodies here concerned are in truth "persistent particles," seemingly having some further office to fulfil, like a reserve stuff left within the sheath "even after" the exogenous and true sporulation phase has been thoroughly accomplished.

As to the term "sporangia," I refer to what I have already said in my reply to Professor Arkövy, *i.e.* that no trace of spore-case, of theca or involving coat, has been hitherto detected around the fruitful heads of racemosa as they appear daily growing upon all the sound teeth.

But as to the first query, namely, whether the new organism may be truly a leptothrix or an aspergillus (see page

43 of these authors), or a mucor, let me repeat here what I already said about the fourth phase (the aerial vegetation) of this organism: "I call it aerial vegetation, because the stems of the microphyte have a tendency to rise in the air although immersed like the algæ. In our case the surrounding liquid is the saliva"—page 88 of my work; and elsewhere, "Neither is it our business to solve the question whether the discussed parasite is a fungus or an alga. We shall only say that it appears to us to partake of the characters of both families, to thrive as an alga, but to fructify similarly to certain fungi." (*Ibid.* p. 178.)

To this it may be added that the aerial vegetation here concerned appears to embrace, besides (a) the fruitful heads, and (b) the lower stumps, even (c) the unripe stems (the supposed Cladothrix or Streptothrix buccalis of Mr. Goadby)—which I met with sometimes intermingled, like so many barren hyphæ or paraphyses, between the fruitful heads—and (d) the male organs spoken of above. Now, by considering such an assemblage of threads thriving upon the matrix felted around the teeth, as well as the dissimilar characters of the respective fructification methods, and of the respective implantation arrangements, it will be evident that the new organism certainly could be related neither to an aspergillus nor to a mucor. The dissimilar character in the fructification methods appears *per se* evident. The implantation arrangement shows, in its turn, in aspergillus and mucor, the hyphæ springing directly by aerial ramifications of the mycelial filaments themselves, while in racemosa the fruitful stems appear, instead, to be engrafted, by a kind of radicular system, upon a pre-existent felting.

On the other hand, the new organism could not be related to the class named by the French mycologists "champignons-algues," *i.e.* to saprolegnieæ and mucorini, inasmuch as the former (saprolegnieæ) bear neither pedicellar nor penicillar tufts, and the latter (mucorini) may thrive in effect as aquatic organisms but exclusively under the dissevered form of ferments, while only by means of aerial hyphæ do they spring penicillar tufts outside the surface of the nutrient medium.

But a botanical diagnosis of the new organism can never be, I think, arrived at without a more exact knowledge of its lower layer, *i.e.* of the creeping chains or bundles and of the matrix felted around the teeth. It is for this reason that, since 1895, the study of the matrix has seemed to me no less interesting than that of the upper tufts, and that in the appendix to my work I gave (at pp. 221, 222) a short account of my researches on the subject; but until now the daily duties of my medical practice together with other obstructions have forbidden me to re-attempt the search. I hope that some other observer more learned in mycological studies will succeed in filling up this blank, and in completing in this way the complex life-history of racemosa, following or rectifying the morphological sketch given by me in the quoted paragraph.

(B) "Is it allowable to accept the theory built up by Vicentini on the subject of the micro-organism which he has discovered? Vicentini, in fact, makes of racemosa a superior organism, a point of departure for all the polymorphous formations (cocci, chainettes, bacilli) which are found in the mouth. That is going back to the ancient theory raised by Robin in his study on the Leptothrix buccalis, which now is only of historic interest." (Page 45.)

But the latter statement, by which my attempt for a simplification of bacterial species seems to have been mistaken for a simple exhumation of old doctrines, will appear in flagrant opposition with the remarks of Mr. Mummery, Dr. Williams, and other observers, who worked at the study of the new organism practically, and who deemed, in their turn, my views to be of a "startling and very revolutionary character." For my part, I am quite sure that when Professor Frey and Mons. Lemerle will undertake a similar practical verification of the facts alleged by me, their opinion will be essentially modified. "Experience has shown, indeed, that those who have not actually verified the fructifications of racemosa with their own eyes can hardly become convinced of the real importance of the new organism." (See my reply to Professor Arkövy, *loc. cit.*, p. 202.)

On the other hand, the recent history of mycetology presents, for the classification of bacterial species, a very close term of analogy, inasmuch as we may meet with there, at every step, a progressive work of simplification in the same sense. "One-half, perhaps, of the old species of fungi have already disappeared; nor would it be surprising if a similar simplification happened even for the bacteria forms. Are not bacteria even lower in the cryptogamic scale, more slender and more exposed to the agents of destruction? No wonder, then, that they possess a greater faculty of adaptation and a more extended polymorphism." (Page 191 of my work.) It is to be borne in mind, moreover, that today fifteen hundred species of bacteria have been already registered, and that their list will rapidly increase during the coming years.

These views, advanced by me since 1895, were confirmed a few years after that date by Dr. Williams, before the New York Odontological Society, in the following terms: "The study of the life-history and pleomorphism of the bacteria found in the human organism has, I venture to say, been too much neglected. The reasons for this may perhaps be partly found in the inherent difficulties of the problem, and also in the pleasure and prestige which the investigator finds in the cataloguing of so-called new species. And although it has from time to time been suggested by those who have studied this subject from the point of view of the botanist and the biologist that the many forms of bacteria known may in many instances represent but passing or accidental phases in the life-history of some organism, although they have pointed out that many fungi whose life-history has been completely followed out have supplied strong evidence that the parent organisms are comparatively few, still the cataloguing of species has progressed until there are now, I believe, not far from a thousand species registered." (*Dental Cosmos*, 1899, pp. 330, 331.)

For other remarks on the subject, chiefly on the insufficiency of the culture and inoculation methods for a right classification of bacterial species, I refer the reader, not only to my work and my subsequent papers, but to the agreement of Mr. Goadby concerning the suggested affinities between various so-called pathogenic bacteria and some higher organisms.

Only, for the sake of clearness, I will repeat here that, in my criticism of the modern doctrine of bacteriology, I raised no question as to laboratory experiments considered within their proper limits (see page 192 of my work), but only as to their interpretation. It was said by Galileo that the experiment is essentially guided by "the discourse of the mind," and by Hegel that "in the experiment one arrives at what was in the will of the experimenter." ("Logic," section 24, elucidation 3.) Now, the doubts which I made bold to advance against the conclusions drawn by laboratory experiments did not regard, for the moment, the facts themselves, but only their misinterpretation arising from that fundamental misconception of the modern doctrine of bacteriology, by which the dissevered bacterial elements were dogmatically assumed as so many independent beings, without any suspicion that they might be, on the contrary, simple scattered particles of more complex ones.

It was, indeed, on account of this fundamental misconception that the great majority of bacteriologists, on being confronted with the fabulous number of dissevered bacterial elements, of the most different forms and sizes, wandering in the mouth (being shed by the new organism into this cavity, and thence through the digestive and air passages), were urged to have recourse to the intervention of other bacterial elements having nothing to do with racemosa, but coming, in their opinion, one by one from without, and thriving accidentally in the buccal cavity. And, what is more singular, these foreign elements would be, according to the same observers, endowed with a power of spreading throughout the whole body, while such a power of diffusion would be denied to the scattered particles of racemosa. But, in the same manner, one might for argument's sake object that the leaves and fruits dropped at the foot of a forest growth proceeded from remote countries rather than from the surrounding trees, and so on.

As to the asserted foreign source of the above scattered elements, I have already shown both in my work and in the papers quoted that, just as with the various thread forms previously mentioned our opponents could by no means be relieved from the *onus probandi* as to this asserted independent entity of all the said dissevered forms of bacteria, which we see in fact daily growing "within" the threads themselves, and especially "within or around" the fruitful stems and the male organs of racemosa, and living there the first stage of their life. As to the forms thriving in the genito-urinary passages, in the section relating thereto (pages 129 to 137 of my work), I likewise showed that, though they do not appear to be derived by direct dissemination from the growth of the mouth, they belong notwithstanding to the same species; inasmuch as, upon certain spires or flakes of urethral mucus they may give rise to "identical fruitful heads of racemosa." Too insufficient, for a classification of bacterial species from the botanical standpoint, would be, on the other hand, the criteria of the shape and staining, or of the so-called pathogenic or non-pathogenic power, etc., for which the morphological study of bacteria "after nature" has been, in the later decades, so completely abandoned.

But, besides this misinterpretation of laboratory experiments, the same misconception attaching to the modern doctrine of bacteriology has so worked that, up to the present time, even the elementary examination of the genuine growths of the mouth was, in its turn, thoroughly misguided, and only their dissevered forms could come into the cognizance of the observers. And thus it happened that "hundreds—and it may be said thousands, perhaps—of expert bacteriologists worked for years at these problems without discovering this important organism." (Williams, *Dental Cosmos,* 1899, p. 348.) But I have shown elsewhere that the carelessness in collecting the *patina dentaria,* and its excessive trituration upon the slide, was the only cause by which, in the hands of the previous observers, the fruitful heads of racemosa were systematically, though unintentionally, destroyed.

(C) Under their final heading the authors come to recall the asserted decalcifying power of racemosa upon the enamel, which, according to them, would present to the dentist the greatest interest. The germ theory of dental decay, advanced first by Ficinus (1847), though the buccal microbes were considered by him to be of an animal nature, may be dated from Robin, who attributed the decalcification of dentin and enamel to his Leptothrix buccalis. This theory was from time to time abandoned and held anew, as in 1867 by Leber and Rottenstein, in 1881 by Milles and Underwood, and lately by Professor Miller and other authors. But, as far as I am aware, after the discovery of racemosa, Dr. Watson has been the first to attribute to this organism an etiological value in dental caries. (See *Dental Record,* 1902, pp. 163-165, and 176, as well as my reply, *Dental Cosmos,* 1903, p. 701.)

Now, by considering from a synthetic standpoint the beauty of the human denture so fittingly emphasized by Dr. Perry, its rôle in utterance, and its more essential part in eating; by considering on the other hand the wonderful harmony between the various histological elements of any single tooth—the hypothesis of Dr. Watson and the authors being once accepted—we could not absolutely state which of the two ought to be more admired by us—whether the wisdom of nature in forming, with the one hand, so essential and perfect parts, or its incongruity in placing soon after, with the other hand, such a tenacious and fatal growth upon the same parts, in order to hasten as far as possible their decay. And still less could we understand why, by good fortune, nature itself should have forgotten to repeat the same play at the expense of other organs or parts of the body upon which bacteria are likewise overspread.

Coming meanwhile to the particulars of the question here concerned, it should be considered, in the first place, that the asserted decalcifying power upon the enamel could not be allowed without sufficient proof, either (a) of such a low percentage of calcium salts in saliva and buccal juices, for the racemosa food supply, as to deprive the enamel prisms of a proportion of their calcium, or (b) of some acid-producing power inherent to this or that micro-organism, by which this or that hard tissue of the teeth would be indirectly dissolved.

But against these assumptions might be objected the frequent occurrence of the caries together with tartar deposits—a coexistence which could scarcely be understood in the presence of an excess of acids and without some superabundance of calcium salts in buccal contents, the tartar being in the main part composed of phosphate and carbonate of calcium, both soluble in the acids. Now, what is more singular, the asserted acid-producer organism (racemosa)—so powerful, according to the authors, in dissolving the compact prisms of the enamel—would appear to be quite unable, in the cases alluded to, to attack the porous and originally friable concretions of the tartar; nay, to be itself liable at last to become in turn imprisoned by them, with its filaments embedded in their mass. It was precisely by this fact that Lebaume and Mandl were led to assume the accumulation of the said filaments as the true and initial cause of the tartar itself.

As to the point (b) in particular, the opinions appear somewhat divergent, in order to designate the single organism or group of organisms which, according to the various authors, would bear an etiological relation to dental caries. By some previous observers, indeed, the decalcifying power in question was indistinctly attributed to foreign bacterial elements, having nothing to do with racemosa (at that time still unknown), while, according to Dr. Watson and these authors, this power upon the enamel would belong now to the racemosa growth itself.

As Professor Miller opportunely said, bacteria do not "make holes in the dentin by boring into it as a worm bores a wood or by gnawing at it as a dog gnaws at a bone. . . . They nourish themselves alone by substances in a state of solution." ("Micro-organisms of the Human Mouth," Amer. ed., p. 211.) And more frequently—I dare add—by substances in a state of dissolution. But, given yet not conceded the asserted acid-producing power, it could in some way be attributed to this or that bacterial element accidentally fallen from the external world into the mouth, but by no means to a growth *congenite*, as it were, and connaturalized with the teeth; as racemosa, which, as we have just now seen, could not have been originally and tenaciously lodged, for such an immanent evil purpose, over the teeth—to a growth destined, in other words, to thrive upon the teeth during the whole life of the host, and whose remains, after the death of the host itself, are neither destroyed for ages—as was proved by Zopf and Professor Miller, by dissolving with acids the dental tartar taken from the Egyptian mummies.

Hence, either the defenders of the germ theory of caries hold, according to the previous observers, that the asserted acid-producing organisms are so many independent beings having nothing to do with racemosa, and then they will have no ground for imputing the evil in question to it; or, in agreement with Dr. Watson and these authors, they will hold, on the contrary, that the said decalcifying power upon the enamel belongs, instead, to the new organism, and then they ought to give some satisfying proof of this statement, in the sense either of the point (a) or of the point (b). In effect, the experiments of the previous observers, in so-called artificial caries, did not regard the new organism at all, and could by no means apply to the case unless the same acid-producing organisms were acknowledged to be nothing but simple appurtenances of racemosa, accidentally endowed with such an acid-producing power. But in this case the opponents themselves would unwittingly fall into line with me, by recognizing (though only in part) the same racemosa growth as the true parent organism of other bacterial elements of the mouth.

In the second place, we may entertain some doubt about the prophylactic value of the daily brushing of the teeth, suggested by Dr. Watson and these authors in order to destroy the racemosa tufts, "and so prevent every kind of caries," inasmuch as Dr. Williams found "the fructification heads of racemosa growing luxuriantly forty-eight hours after thorough cleansing of his own mouth by the aid of tooth-brush, pick, silk floss, and powerful germicides." (*Dental Cosmos*, 1899, p. 346.) We may remember on the other hand that the primordial human races, who knew neither tooth-brushes nor powders, enjoyed in their turn the best teeth in the world.

In the third place, the asserted decalcifying power of racemosa, when real, could at the most be imputed to the matrix or lower layer of the growth, which lies just in immediate contact with the tooth, rather than to the tufts, which thrive, instead, in the upper layer. But the matrix in its turn could still less be removed by the brush, as the above rapid reproduction of the tufts themselves plainly shows. Nay, it could be asked whether such an abrasion of the upper tufts could rather succeed in promoting the vitality of the lower and creeping portion of the growth, in the same way as pruning, for instance, far from eradicating the trees, appears to favor their development; and shaving, far from depilating the chin and cheeks, succeeds rather in promoting hirsute growth.

According to the authors, however, the suggested decalcifying power of racemosa would work only in "opening a door" through the enamel, to other numerous micro-organisms coming from without and destined, secondarily, to invade the dentin; because "The diameter of a filament of leptothrix is considerably greater than that of a dentinal tube," and "It could not penetrate it, as supposed by Robin." (Frey and Lemerle, *loc. cit.* p. 43.) Then the foreign bacterial elements alluded to would succeed in "decalcifying the dentin, caries on the whole remaining," in the opinion of the authors, "essentially a polymicrobic affection." But why such a duality of decalcifying agents, the one (racemosa) for decalcifying the enamel, and the other (the group of the foreign bacterial elements) for decalcifying the dentin? Could not the latter elements play, on their own account, both parts, by decalcifying in the first instance the enamel, without the aid of racemosa, and in the second instance the dentin? If, for dissolving one by one each hard structure of the teeth we would require a particular species or group of micro-organisms, a previous rank of the same ought to precede the invasion of the above two, at least in the younger persons, who have the enamel cuticle or "Nasmyth's membrane" still alive and sound, inasmuch as the enamel prisms could not be dissolved from without until this involving and protective coat would be at work.

On the other hand, the breadth of the stems and filaments of racemosa cannot be assumed in a character discriminative between the bacterial elements met with in the lumen of the tubules (see later on) and the new organism, whose smaller appurtenances, as the sporules, the comma, the reserve gemmules, etc., should rather be ranged among the most minute bacterial elements in our acquaintance. This in the normal condition of the tubules; while, in cases of softening and enlargement of their lumen, even conspicuous threads, resembling in size and shape those of racemosa, may be found so well within the tubules.

By glancing, indeed, at the drawings supplied by Zopf, by Professor Miller, and other authors, everyone can see that the cocci, bacteria, comma, and bacilli, filling there the dentin tubules, appear not to differ substantially from the respective minute particles of racemosa. See, for instance, Miller, "Der Einfluss d. Mikro-org. a. d. Caries, etc.," in *Klebs' Arch.*, xvi, Fig. 7, and "Micro-organisms of the Human Mouth," Figs. 78, 81, 82, 83, and 84. The softened and enlarged tubules may be filled moreover with some thread forms intermingled with the dissociated ones ("Micro-organisms of the Human Mouth," Fig. 80, and Plate I, Fig. 1), or longitudinally stuffed with masses of very long threads, and almost the whole basis-substance transversely riddled here and there by the said threads (see the beautiful specimen drawn in Fig. 85 of the same treatise) ; so that the penetration of the above bacterial elements within the tubules, rather than the initial cause of the caries, will appear a quite natural phenomenon (see later on), and their luxuriant multiplication in carious dentin will appear to be, in its turn, nothing but a simple consequence of the previous softening and decay of the hard tissues of the teeth, induced by ill-development, by pathological conditions, local or general, by chemical changes, and by other predisposing or actual causes of the caries itself. A confirmation of the kindred between the said forms of bacteria and racemosa may be found, moreover, in the very interesting specimens drawn in Figs. 63 and 79 of the same work, where within a carious cavity and "on the border of a section of decayed dentin, appear fringes of leptothrix threads"—which, according to me, do not differ in any respect from the barren tufts of racemosa thriving on the cuticle of the tongue.

The question put by Dr. Watson and the authors appears, on the other hand, so intimately connected with that of the pathogenesis and etiology of dental caries that it cannot be rightly understood without rushing into such a special field ; but, for my part, owing to my incompetence in dental pathology, I am not in position to engage *ex professo* in the controversy. I will content myself with observing that the teeth are not only nourished but endowed besides with some sensitive faculties, by the living constituents lodging within them, and consequently that the process of their decay cannot be rightly understood without a careful consideration of the part which these living constituents must essentially play in all their life-changes, both in health and disease. Now, for the medical men working with the microscope for clinical purposes, to which my work was chiefly addressed and who could be perhaps less familiar with the dental histology, I dare remember that, during the living condition of the dentin, the tubules, traversing the basis-substance, are not empty, but contain slender protoplasmatic protrusions, emitted from the "odontoblasts" of Brücke, *i.e.* from the living corpuscles placed uprightly on the superficial layer of the pulp (the dentinal membrane of Kölliker). According to various observers, some slender nerve fibers could be detected besides within the tubules.

The above radiating protrusions were noticed first by Mr. Tomes, in 1856, confirmed by Dr. Beale in 1860, in the shape of thin fibrils of living matter, moist but tolerably firm, filling (chiefly in younger persons) the lumen of the tubules throughout, and penetrating for a short space even within the enamel. See Beale, "The Structure and Growth of the Tissues," Figs. 65, 67, and 68, as well as the drawings supplied by Gysi and Röse, and other authors. The numberless ramifications and anastomoses of these fibrils form a delicate network, particularly near the enamel, while other protoplasmatic masses lie in the stratum granulosum of Tomes, likewise near the enamel and the cement, as well as, here and there, in the "interglobular spaces" of Czermak, within the lacunæ of the basis-substance.

From which it will appear that the life of the whole tooth, and of the dentin in particular, depends chiefly on the healthy condition of the pulp and its appurtenances. Nevertheless, the connection between the living corpuscles of the cement and those of the pericementum or periosteum on the one side, and on the other between the cement itself and the ivory of the roots, through the stratum granulosum, works so that, even after the total destruction of the pulp the roots and the remains of the crown may, though imperfectly, survive and continue to work by the aid of opportune fillings or inlays. Whether the Nasmyth's membrane may concur in some way to help the normal condition of the enamel, it being, according to Mr. Tomes, a continuation of the cement with analogons corpuscles in the depressions of the molars, we at present could not precisely state. At any rate, we may understand how much (chiefly in the crown) the free circulation, both of the nourishing pabulum and of the nervous impulses, through the maxillary bones, the root-canals, the pulp, the fibrils, the lacunæ, and the stratum granulosum, may be liable to disorder. It was, on the one hand, by this labyrinthic disposition of canaliculi and lacunæ that these "hardest structures" of the body could be effectively enabled to live, and it was by their implantation on the border of likewise canaliculated bones that their steadiness and their communication with the circulatory and nervous systems could be secured. But it is, on the other hand, in this same disposition that, according to me, may lie one of the predisposing causes of dental caries. It should be considered, in other words, whether, apart from the obvious and grosser forms of disease, as pulpitis, atrophy, dissolution of the pulp, etc., some other unknown and finer derangement in bloodvessels, in nerve fibers, in connective tissue, in odontoblasts and fibrils, in the protoplasmatic masses, or in other peculiar histological elements of the pulp itself, as well as other mischiefs in the pulp-chamber, in the roots, etc. (together with the external injuries, chemical changes, and the other local or general conditions above mentioned), rather than the aggression of bacteria, might effectively play the main part in dental caries.

Meantime I will note in passing that the above survival of the roots, thanks to the living power of the corpuscles of the cement, would give us a confirmation of the view previously suggested about the previous "loss of power" undergone by the living constituents lodging within the stratum granulosum, the lacunæ and tubules, as one of the actual causes of decay, without which the same decay process, in spite of the multitude of bacteria, could proceed no farther. Professor Miller attributed the arrest of the carious process in "closed root-canals" to the "want of carbohydrates, essential to the formation of acids" (*loc. cit.* p. 213); but how could we explain the survival of the "unclosed" roots?

Returning now to the caries of the crown, we could not avoid asking—(a) Could bacteria penetrate the tubules, and (b) thrive and multiply within their lumen, while the fibrils radiating from the pulp are still alive and healthy? Professor Miller *a priori* answered in the affirmative, and, in many specimens of sound dentin, under high powers, he could really succeed in detecting a small number of bacteria, but "without any visible changes" in the structure (*loc. cit.* p. 179). These bacterial elements, in other words, were manifestly living there in a state of "quiescence." Thus, to be exact, the first point (a) of the query was practically answered in the affirmative, the second (b) only in the negative.

From which it will appear that, as I have shown elsewhere, the bacterial elements are by their nature ubiquitous, but that they have no power upon living and healthy structures—*i.e.* in our case, a sound dentin—a conclusion which, in relation to decayed teeth, would be fully confirmed by another fact alleged by the same author, viz, that in decayed dentin "the softening (decalcification) extends farther than the invasion of micro-organisms," and by the agreement of Dr. Watson with this statement, by saying that "There are areas of softened non-infected dentin which contain no organisms." (*Ibid.* pp. 175 and 177.) By glancing moreover at the respective drawings (Miller, *loc. cit.* Figs. 68 and 69), everybody can see how much the surrounding zone of softened but still uninvaded dentin extends more widely than the central area already invaded by bacteria, and how the latter, rather than preceding as the vanguard, seem only to follow, as it were, as the rearguard of the softening process.

Professor Miller explained the fact by saying that "the action of acids always precedes the invasion of bacilli" (*ibid.* p. 180), so that, according to the learned professor, in the beginning of caries some peculiar bacteria would work outside the teeth in elaborating acids at the expense of the carbohydrates; these acids would subsequently penetrate and dissolve the hard structures, independently of the direct concourse of the microbes, and lately, either the same bacteria above mentioned, or other microbes from a different source, would invade the already softened structures, following far off the steps of the softening process, to the effect of peptonizing and dissolving the albuminous constituents of the basis-substance (*ibid.* p. 211). Now, the due reservations being made on the first two statements of the author, we may freely agree with the latter one. Nay, I have already dealt, for my part, with the normal peptonizing and digestive power of mouth bacteria through the alimentary canal, at pp. 131, 132 of my work. I have moreover met with cases of digestive troubles arising, with the greatest probability, from the daily brushing of the teeth; so that such a systematic abrasion of racemosa growth would seem not only, as we have seen above, to be quite unable to preserve the enamel from the acid-producing power attributed to the same organism, but sometimes to impair the function both of the oral and of the gastric digestion. The said peptonizing and digestive power of mouth bacteria does not exclude, however, their cleansing power at the expense of the decayed cells and of the corrupt matters, to be eliminated from the living economy, which according to my view would constitute their more essential function.

Against the above statement, that bacteria in their normal condition have no power upon sound structures, it could be objected that in laboratory experiments many of them show very hurtful properties, on which the doctrine of their so-called pathogenic power was established. But I have already dealt, and somewhat largely, with this subject in the section referred to from page 203 to 216 of my work; and again more recently, both in my reply to Mr. Mummery (*Dental Cosmos*, 1901, pp. 860-863) and in my third reply to Mr. Goadby (*ibid.* 1903, pp. 706-708). I have shown that the bacterial elements thriving in our body are nothing but scattered particles of racemosa, having an essential office to fulfill through the whole economy, in the sense above suggested; that likewise most of the so-called bacterial species, nursed in artificial culture soils, are not true independent beings, taken from the external world, and kept in their natural and original "free state," but particles of racemosa, more or less modified, and purposely and artificially collected from this or that morbid seat or product, together with the accompanying refuse, corrupt, virulent, or cadaverous matters, destined to be eliminated from the previously affected organism rather than to be inoculated into a sound one; and consequently that the hurtful properties attributed to such bacterial particles, often enforced by the decomposition of the particular culture medium, far from being inherent in their "botanical entity," appear only to be borrowed from the morbid seat or product from which they had been taken, or to be brought about in this or that laboratory experiment, "by the experiment itself."

I have likewise shown that on account of other pathological conditions the sudden "multiplication" of bacterial elements, previously quiescent in the morbid seats of the body, neither precedes nor accompanies, but only follows the disease (see pp. 195-199 of my work), and that the simple presence of bacteria in this or that part of the body is merely to be attributed to the ubiquity of their particles spoken of above. Hence it will appear quite evident that, for the invasion of the teeth, no peculiar pioneer (as racemosa) would be required in order to "open a door" to the spreading bacteria, who are already dwelling there, and that the abrupt "multiplication" of such bacteria, as in other morbid seats in the body, far from being an immediate result of the simple presence of the above quiescent elements, is to be attributed to the "alteration supervening in the soil," *i.e.* to the previous loss of power, to the disintegration, decay, or decomposition of the already affected parts, upon remains of which the bacteria, aroused from quiescency to activity, are called suddenly to thrive and multiply, as scavengers or necrophagous agents, very luxuriantly. *Corruptio unius, multiplicatio alterius.* It is, in other words, the same old adage, modified alone in the second term, that maintains all its value even at present.

As we have just now seen, the life of the dentin is intimately connected with that of the fibrils. Are these protoplasmic protrusions, indeed, which, together with the protoplasmic masses spoken of above, constitute the "living parts" of the ivory, and who feed and control, perhaps, the same "intervening substance" between the prisms of the enamel? But the fibrils themselves are so liable to disintegration that, according to Dr. Beale, in order to show them, soon after the extraction of the respective tooth the pieces of broken dentin with portions of the pulp still adhering must be immediately immersed in carmine fluid (Beale, *loc. cit.* lecture vi, and "The Microscope in Medicine," 4th ed., p. 109). From which it may be plainly understood how very readily such protoplasmic radiations of the pulp may undergo disintegration, and how consequently any slight derangement in their molecular condition may give rise to a softening or decay process in the dentin.

Specimens of cross sections of normal

dentin, showing a number of tubules empty between the other tubules still filled with the respective fibrils, were already supplied by Tomes, and it could be asked whether such a loss of fibrils might be considered as one of the predisposing or actual causes of future decay. Swellings of the fibrils, within the softened and enlarged tubules of carious dentin, were on the other hand described by many observers; but in the lumen of the tubules filled with bacteria no residual trace of fibrils could be perceived. (See the drawings above referred to, especially that of the *Klebs' Arch.*, with which I dealt in passing at pp. 188, 189 of my work, or that supplied by the late Professor David, "Les Microbes de la Bouche," Fig. 94, etc.)

In the extracted teeth, after the death of the dentin and pulp, the tubules may retain only a few remains of the respective fibrils, becoming in their turn the seat of a retrogressive process, by the oozings of the embedding mass, until the tooth itself becomes dry, and owing to the reabsorption of the fluid matters the tubules become almost completely empty. The whole tooth is then converted into a thick, porous shell of solid matter around a central cavity. Hence we may entertain some doubt about the value of the experiments of artificial caries, by plunging cubes of dead dentin in solutions containing carbohydrates with saliva and bacteria of the so-called acid-producing class; inasmuch as it is precisely at the expense of such corrupt matters, stagnant within the intricacies and recesses of a porous and lifeless structure, that bacteria have the strongest tendency to thrive and multiply.

In effect, until the fragments submitted to experiment were kept dry, any retrogressive change in their own constituents could remain suspended, but by the subsequent imbuing with fluid matters in a state of decomposition the dentin tubules and the basis-substance become practically no less liable to softening, decalcification, and fusion than in spontaneous caries. In both cases—in spontaneous and in artificial caries—the key of the result appears therefore to be nearly the same, *i.e.* the previous alteration of the living constituents of the tooth. For performing, then, a conclusive experiment it would need (when possible) to submit to the same treatment a sound dentin with healthy fibrils still lodging within the lumen of the tubules and radiating from a healthy pulp—in other words, a living and sound tooth rather than a dead and defective one.

Meanwhile, unyielding adherence to the germ theory of caries has so worked that, in dealing with the "transparency of the dentin," and with the very interesting occurrence of the "spontaneous healing" of caries, but little attention was paid by Professor Miller and other observers to the "repairing power" of the fibrils in the latter process, as counteractive of the previous softening of the dentin and the aggression of bacteria. Cases of spontaneous healing of caries may really occur, though comparatively seldom, in the permanent first molars and in deciduous teeth, where the destructive process may cease spontaneously and the already softened dentin may become hard again. According to Professor Miller, "The invasion of bacteria in the cases examined had been superficial, a fusion of the basis-substance had not taken place, and the dilatation of the tubules was confined to the external layer." From which the author himself was led to the conclusion, either of "the possibility of a recalcification of the dentin and of more or less complete restoration of the calcium salts of the decayed dentin through the medium of the pulp (a virtual *restitutio ad integrum*)," or of "the possibility that new dentin may be formed at the expense of the fibrils, in the manner described under transparency of the dentin." (*Loc. cit.* pp. 202-204.)

Now, what more peremptory proof of the repairing power of the fibrils, and consequently of the main part that they would play in the whole process of dental caries? Here we see, in fact, that when the fibrils had been only partially deranged (at their distal extremity, near the enamel), the fusion of the dentin and the subsequent multiplication of bacteria could proceed no farther, and that, as long as the respective sector of the pulp was still alive and sound, some new shoots of the fibrils themselves could regain, moreover, the ground previously abandoned within the respective tubules, and could succeed in this way in repulsing the bacteria already growing there and in restoring the decayed ivory.

Without surpassing, I repeat, the boundaries of my own studies, I leave to competent observers particularly learned in dental pathology, to clear up this vexed question of dental caries, upon which I have been incidentally led to touch only in passing. The close relation between dental diseases and the chemical changes in saliva and buccal juices, "independently of the concourse of micro-organisms," was largely illustrated before the Third International Dental Congress by Dr. Michaels in his well-known "Essay on Sialo-semeiology." And that the germ theory of dental caries was still far from being universally accepted appeared likewise from the communication delivered by Dr. Eben M. Flagg of Asuncion, Paraguay, before the same congress, in order to show caries to be, according to him, an "eruptive disease," proceeding from the inner to the external parts of the tooth. The latter views seem in some way to agree with my own, but I am not acquainted with the arguments alleged by Dr. Flagg in support of his statements.

At any rate it is to be hoped that a practical and careful study of the new organism, though from such a limited and disputable standpoint as that of its eventual relation to dental caries, may concur in some way to clear up the morphology and biology of racemosa, as I have repeatedly requested, and that by this kind of work—for which these authors seem to be so largely equipped—more light will be thrown on the subject.

[For the short summary of Dr. Vicentini's paper by Dr. W. D. Miller, with brief discussion thereupon, see page 291.]

The CHAIRMAN (Dr. R. H. Hofheinz). I wish to make an official statement at this time about the paper by Dr. D. D. Smith of Philadelphia, which is on the program of this section. He was to read a paper entitled "Pericemental Abscess." He was present on Monday last and came to the table and requested me to put his paper down for reading that afternoon. I told him that was absolutely impossible. He then requested me to put it down for the next day, to be read the first thing in the afternoon. I told him that too would be impossible because Dr. W. D. Miller was to read his prize paper at that time. Dr. Smith then requested me to put his paper down as the second one. I told him that would be done *if possible*.

I am sure all of you who were present will remember the difficulties we labored under that Tuesday afternoon, as Dr. Kirk could not get the lantern to operate satisfactorily and his efforts consumed nearly an hour. You will remember that I had a paper by Dr. Hopkins read, but that paper was not discussed at that time. Dr. G. W. Cook requested me to postpone the discussion, as his paper had a direct bearing on the subject of that of Dr. Hopkins. The lantern could not be used at that time, and I then requested Dr. Cook to read his paper.

Dr. Smith came to the table and demanded that his paper be read as the second on the program, stating that I had promised him that I would so put it down. I told him that my promise was only a conditional one. He, however, insisted, and I told him I could not then grant his request. He then told me that he could not do anything but leave, and he bid me good-by. I begged him to be reasonable in view of the disadvantageous circumstances under which we were then laboring; but he said the only thing he could do was to say good-by. I then said that the section would rather dispense with his paper than to endure the unreasonable action he had shown. I now beg the section to decide what shall be done with Dr. Smith's paper.

Dr. KIRK. In order to bring this question regularly before the section for action I move that the record of Dr. D. D. Smith's paper be expunged from the program of the section.

Dr. RHEIN. I second the motion.

The question having been duly put by the chairman, the motion was unanimously adopted and the stenographer was instructed to make a copy of the proceedings in this matter and communicate them to Dr. Smith, and also to return his paper.

Dr. E. C. KIRK then made the following remarks on the paper on Sialology by Dr. JOSEPH P. MICHAELS, Paris, France, entitled "Diagnosis of Diathetic Diseases by the Study of the Mixed Saliva" [see opposite page for paper in full]:

I want to thank Dr. Michaels publicly not only for the suggestion he has made, but also for the enthusiasm with which he has been able to infect me in carrying on this work. In the beginning it was like the study of the Rosetta Stone to Egyptologists. Medicine is familiar with the examination of urine as a means of diagnosis, but Dr. Michaels claims that saliva furnishes a more reliable picture than the urine because what we find in the saliva represents the waste products of nutrition dialyzed through the glands. They are the ash, the overflow of nutrition. If we can interpret what they are and what they mean we have done much to solve the problem. I am happy to say that in my own work I have been able to determine the chemical character of some ten or twelve of these important chemical substances, and the more I can determine the more accurate the picture becomes.

I do not like to say too much about it, as I am enthusiastic by nature and I may overstate the case. But I have been able to make saliva readings which have indicated certain liver diseases—particularly cirrhosis—and in conjunction with the urine to determine the causes of certain cases of neurasthenia with excessive nervous manifestations, and, by understanding what was the irritating chemical agent producing these outbreaks, to suggest a certain therapeutic treatment which has corrected it and so borne out the laboratory experimentation.

I want to bear testimony to the practical value to dentistry, to humanity, of the work that Michaels has presented. In making his salivary records it is his routine custom to carry through a corresponding investigation of the urine. His methods of uranalysis are not those of the ordinary analyst, but he applies the same methods to the study of the urine that he does to the saliva.

I believe that along this particular line of work, dentistry will ultimately make to medicine a contribution of almost equal value to that which it made by its contribution of anesthesia. (Applause.)

The Chairman: Dr. Kirk has spent much time and intellect upon the working out of this problem, and we thank him for his kindness in presenting it in such an able way.

Dr. M. L. Rhein, New York, N. Y. I want to emphasize what Dr. Kirk has said about our obligation to Dr. Michaels for his work. The chemical analyses of the oral fluids will never in themselves give sufficient data upon which to base a careful diagnosis of constitutional ailments. I say, not in themselves, but in conjunction with a careful clinical examination of the minor differences that present themselves to the eye in the mouths of people whose equilibrium is more or less divergent from the normal. In this I think it will play an important part and will form the basis of very accurate diagnosis.

The paper in full as presented by the essayist, Dr. Joseph P. Michaels, Paris, France, here follows:

Du Diagnostic des Maladies Diathésiques par l'Étude des Caractères Organoleptiques, Chimiques, et Microchimiques de la Salive Mixte.

Par M. JOSEPH P. MICHAELS, Paris, France.

CHAPITRE I.

De la valeur théorique et pratique de la sialologie dans le diagnostic des états diathésiques. Essai de classification des états diathésiques.

Au côurs de ma longue pratique de l'art dentaire, j'ai été amené à rechercher l'influence de l'état chimique de la salive sur la production et sur l'évolution plus ou moins rapide de la carie des dents. J'ai ainsi pu remarquer que toute salive d'un même type chimique correspond à un même état général. Après de multiples observations, j'ai réussi à établir la formule salivaire d'un certain nombre d'états dyscrasiques. Analysant moi-même la salive, j'ai souvent fait analyser, à titre de contrôle, les urines de mes malades, par un chimiste biologiste distingué: le diagnostic urologique a toujours confirmé le diagnostic sialologique.

Et pourtant ma méthode d'analyse de la salive est très simple. Point n'est besoin d'être un chimiste expert pour l'appliquer. Tout médecin, tout dentiste, peut pratiquer lui-même l'analyse de la salive pourvu qu'il possède quatre ou cinq

réactifs simples, un microscope, un polariscope, et qu'il veuille bien consulter les tableaux que nous publions ici.

Il est inutile de rappeller les difficultés que présente une analyse complète des urines: un chimiste seul peut la faire dans son laboratoire.

Cette simplicité de ma méthode sera évidente pour tous ceux qui voudront bien lire ce mémoire: j'y attache une grande importance. Car parmi tous les procédés nouveaux d'exploration médicale, bien peu sont utilisables pour le praticien: la plupart resteront toujours des procédés de laboratoire.

C'est à cause de cette simplicité de ma technique et des résultats précis qu'elle donne que je me permets de rappeler encore une fois l'attention sur la valeur de la sialologie dans le diagnostic des affections dyscrasiques.*

Il suffit du reste de réfléchir un instant aux lois les plus fondamentales de la pathologie générale pour comprendre la valeur au moins théorique de la sialologie dans ce cas.

Dans un être vivant, tous les organes sont solidaires; un trouble morbide portant sur un point particulier d'un organisme entrainera des modifications infinitésimales mais toujours existantes des autres organes et de leurs sécrétions.

Or un trouble morbide, c'est un trouble chimique: les maladies microbiennes sont le plus souvent causées par les toxines que secrètent les microbes; les maladies diathésiques résultent des troubles de la nutrition. Si donc, on pouvait analyser complétement une sécrétion quelconque de l'organisme on pourrait par la même diagnostiquer l'état général de l'organisme en question.

La difficulté, au point de vue pratique c'est d'avoir des réactifs assez sensibles permettant de différentier des états chimiques très voisins. Un principe chimique, pour se répandre dans tout l'organisme, passe par différents stades. Dans un premier stade, il reste cantonné à un organe; dans un deuxième stade, il modifie la constitution physiologique du sang et de la lymphe. Ce n'est que dans un troisième stade qu'il affecte le chimisme des sécrétions et des excrétions; de plus, certaines glandes laissent passer plus facilement que d'autres les produits contenus dans le plasma sanguin. Or, le mécanisme de la sécrétion salivaire se compose de deux phases successives: dans la première phase, il y a filtration du plasma sanguin dans les lacunes lymphatiques qui entourent les acini glandulaires: cet acte est sous la dépendance des nerfs vasculaires, nerfs qui, règlant la circulation glandulaire, règlent la quantité des matériaux sanguins dont les cellules salivaires peuvent disposer. L'acte essentiel de la sécrétion salivaire est sous la dépendance des cellules des glandes salivaires et des nerfs sécréteurs. On voit donc que les cellules glandulaires, par leur activité propre peuvent modifier la nature des produits fournis par le sang, et même empêcher ces produits de passer dans le liquide secrété.

C'est pourquoi nous avons seulement étudié les variations de la salive dans les états dyscrasiques. Dans les maladies aigues, les troubles chimiques des divers organes n'ont pour ainsi dire pas le temps de s'installer d'une façon complète. Du reste, nous ne voyons pas bien à quoi pourrait servir l'analyse de la salive chez un typhique, chez un diphtérique par exemple. En dehors des phénomènes cliniques qui sont de toute évidence, il y a des procédés nouveaux scientifiques (sero-diagnostic, bactériologie,) qui ont ici beaucoup plus d’importance que n’en saurait jamais avoir l’analyse de la sécrétion d’une glande. L’urologie ne sert pas ici, comme dans les maladies chroniques, à faire le diagnostic de l’état général. Sans doute, dans la fièvre typhoide, Ehrlich, par la diazo-réaction, en arrive à reconnaitre souvent la maladie causale; mais même dans ce cas de fièvre typhoide l’analyse des urines ne sert le plus souvent qu’à préciser l’état particulier du filtre rénal, à déterminer sa valeur éliminatrice des poisons de l’organisme.

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* Voir communications précédentes et surtout ma communication au Congrès dentaire international de 1900—Paris.

Dans les états dyscrasiques, au contraire, ce qui domine, c’est le trouble chimique de l’organisme entier. Ces dyscrasies sont le plus souvent greffées sur une diathèse préalable. Par ce mot diathèse, en effet, il faut entendre, à l’exemple de Bouchard, un tempérament morbide: c’est du reste son sens traditionnel. Hippocrate appelait diathèse la manière d’être, et admettait une diathèse de santé et une diathèse de maladie. La diathèse, n’étant qu’un mode particulier de la nutrition, se traduit par une modification de l’équilibre chimique de l’organisme, trouble qui peut précéder pendant de longues années toute modification symptômatique appréciable. A cette période propathique, l’état diathésique ne se traduit que par des symptômes subjectifs que le praticien ne pourra pas rattacher à leur véritable origine s’il n’est guidé par l’histoire du malade et de sa famille, et par l’analyse chimique des urines. A la période virtuelle, latente, la dyscrasie est constituée, mais elle ne se traduit par aucun symptôme caractéristique; la révélation de l’état morbide est imminente: la dyscrasie va se manifester par des symptômes subjectifs et objectifs nets. Dès lors, ces périodes d’état réel alternent avec des périodes d’état virtuel, la maladie en arrivant peu à peu à sa dernière phase, période ultime, avec collapsus et mort. Et à ces divers stades, correspondent des troubles chimiques différant en intensité, sinon en nature.

L’analyse de la sécrétion salivaire a donc ici son maximum d’indications, puisque cette sécrétion présente, dès la période propathique, des modifications assez considérables et, que, dès cette période, il est possible de décéler pour chaque état, des modifications caractéristiques; puisque, d’autre part, au fur et à mesure que la dyscrasie évolue, le chimisme salivaire évolue d’une façon parallèle, permettant ainsi le diagnostic de la maladie. Par la sialologie, comme par l’urologie, le diagnostic peut être précoce; les données de l’une et de l’autre science se confirmant, il est certain et entraine la prescription immédiate d’un traitement prophylactique ou curatif, suivant les cas, empêchant la dyscrasie d’évoluer vers son stade ultime.

Grâce à la biochimie, le malade pourra être traité aux périodes propathique et virtuelle de sa diathèse, c’est-à-dire aux périodes où le traitement a son maximum d’influence, en tous cas, bien longtemps avant le moment où la clinique, laissée à ses seules forces, eut pu permettre de le formuler.

Bien plus, la biochimie salivaire, urinaire, montrant la prédominance constante d’un produit pathologique dans un état morbide, permettra peut-être un jour de découvrir la cause réelle de ces états dyscrasiques et de remplacer ainsi la médication symptômatique ou hygiénique prescrite à l’heure actuelle, par une médication pathogénique, véritable but de la médecine scientifique.

Ainsi, pour nous, le domaine de la sialologie est bien délimité: La *sialologie* est une science qui permet *d'etablir le diagnostic*, et par consequent, le *traitement d'une dyscrasie des les périodes propathique et virtuelle.*

Nous n'avons pas l'intention de développer ici la théorie des phénomènes de la nutrition ni d'étudier toutes les modifications qui peuvent se produire dans l'équilibre nutritif d'un être vivant. Nous voudrions seulement exposer quelques idées nous permettant d'en arriver à une classification des dyscrasies dans lesquelles nous avons pu établir des types salivaires assez bien définis.

Chez les êtres supérieurs, les phénomènes de nutrition peuvent se ramener à six actes principaux.*

(1) *Apport des aliments par le tube digestif et transformation des aliments par les sucs qui s'y deversent.* Ces transformations ont pour but d'hydrater les substances pour les rendre dialysables; l'amidon est saccharifié; les albumines se peptonifient; les graisses sont en partie émulsionnées, en partie dédoublées en acides gras et en glycérine.

(2) *Absorption.* Les matières grasses dialysables traversent la paroi intestinale.

(3) *Deshydratation des aliments qui ont été hydratés dans la cavité gastro-intestinale.* Cette deshydratation commence dans les parois intestinales où les peptones reforment de nouvelles albumines, où les graisses dédoublées se combinent de nouveau; elles s'achèvent dans les ganglions lymphatiques et dans le foie qui arrête les acides gras, les peptones, le sucre. La glucose est deshydratée et forme une matière analogue à l'amidon, le glycogène, qui s'accumule en grande partie dans les tissus, dans les muscles et surtout dans le foie.

(4) *Nutrition des cellules.* Les cellules puisent dans les plasmas interstiticiels les matières dont elles ont besoin et y rejettent les substances inutiles qui passent dans le sang pour être éliminées.

(5) Mais pour que ces matières puissent quitter facilement l'organisme, il faut qu'elles redeviennent dialysables. Le foie joue ici un rôle très important: c'est dans son parenchyme que les produits azotés subissent la transformation ultime qui les amène à l'état d'urée, corps cristallisable qui quittera facilement l'organisme et agira comme diurétique.

(6) *Rejet par les emonctoires des substances inutiles.* La première place appartient aux poumons et aux reins, puis viennent la peau et les diverses glandes à conduit excréteur.

Ces six ordres de phénomènes peuvent se ramener à deux phases primordiales: l'assimilation A (1, 2, 3), et la desassimilation D (4, 5, 6).

A l'état normal, l'état de nutrition N, varie suivant l'âge et suivant certaines conditions physiologiques.

Chez l'adulte $A=1 \quad D=1 \quad N=1$.

L'enfant présente une ration d'entretien, si bien que chez lui $A>1 \quad D=1 \quad N>1$.

Chez le viellard, au contraire, les phénomènes de désassimilation l'emportent sur les phénomènes d'assimilation, si bien que l'on a $A=1 \quad D>1 \quad N<1$.

De même, la nutrition est modifiée chez la femme enceinte, chez la femme qui allaite, etc.

Pathologiquement, l'état de nutrition est altéré dans toutes les maladies aigues ou chroniques. Nous ne nous occuperons ici que des variations de la nutrition dans les maladies chroniques, dans les dyscrasies.

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* Voyez Roger—Introduction à l'étude de la médecine.

Théoriquement, nous avons deux données A et D qui peuvent varier par rapport à l'unité (normale) et par rapport entre elles, la valeur de N se déduisant de ces variations. On ne peut donc avoir que les combinaisons suivantes:

$$\begin{array}{llllll}
1\ \begin{matrix}A=1\\D=1\end{matrix} & N=1 & 2\ \begin{matrix}A=1\\D>1\end{matrix} & N<1 & 3\ \begin{matrix}A=1\\D<1\end{matrix} & N>1 \\
4\ \begin{matrix}A>1\\D=1\end{matrix} & N>1 & 5\ \begin{matrix}A>1\\D>1\end{matrix} & N=? & 6\ \begin{matrix}A>1\\D<1\end{matrix} & N>1 \\
7\ \begin{matrix}A<1\\D=1\end{matrix} & N<1 & 8\ \begin{matrix}A<1\\D>1\end{matrix} & N<1 & 9\ \begin{matrix}A<1\\D<1\end{matrix} & N=?
\end{array}$$

Dans les combinaisons 5 et 9, N peut être soit =, soit>soit <1, suivant les variations quantitatives de A et de D entre elles. Peu nous importe du reste. Car, dans tous les cas, dans ceux-ci comme dans les autres, (1, 2, 3, 4, 6, 7, 8) N ne peut avoir que trois valeurs:

$N=1$ normale.
$N>1$ combinaisons 3, 4, 6.
$N<1$ combinaisons 2, 7, 8.

Or, tous les cas en déficit (2, 7, 8) comportent une diminution de l'acidité sanguine, une diminution de l'acidité urinaire. Tous les cas en excédent (3, 4, 6) comportent une augmentation de l'acidité urinaire.

On peut donc décrire avec Gautrelet:

(1) *Des maladies avec hypoacidité organique, maladies avec défaut de nutrition.* (a) Par exagération de la désassimilation (cas 2); (b) Par diminution de l'assimilation (cas 7); (c) Par exagération de la désassimilation et diminution de l'assimilation (cas 8).

(2) *Des maladies avec hyperacidité organique, maladies avec excédent de la nutrition.* (a) Par exagération de l'assimilation (cas 4); (b) Par diminution de la désassimilation (cas 3); (c) Par exagération de l'assimilation et diminution de la désassimilation (cas 6).

Certaines maladies, au cours de leur évolution font tour à tour partie du groupe hyperacide et du groupe hypoacide.

Nous ne nous occuperons, dans les pages qui vont suivre, que des maladies se greffant sur un état diathésique.

I. MALADIES AVEC HYPOACIDITÉ ORGANIQUE.

C'est dans ce groupe que rentre la diathèse scrofuleuse. Nous n'entendons sous ce mot que ce tempérament spécial de certains enfants lymphatiques, adénoidiens le plus souvent, et qui sont plus sujet que d'autres à la gourme, à l'otorrhée, aux écronelles, aux tuberculoses locales ou généralisées. La scrofule—le lymphatisme ainsi compris ne comporte plus guère la division en quatre périodes que Bazin décrivait à son évolution.

II. MALADIES AVEC HYPERACIDITÉ ORGANIQUE.

Dans ce groupe, rentrent les maladies par arthritisme de Bazin (1859), par bradytrophie de Bouchard (1882), par herpétisme de Lancereaux (1883), par hépatisme de Glénard (1892).

Il n'est pas de notre but de discuter ces différentes théories. Il nous semble toutefois que la plus rationnelle est peut-être la théorie de l'hépatisme.

Quatre ordres d'arguments nous poussent à l'admettre comme base de notre travail:

(1) *Des arguments anatomiques:* l'apparition précoce du foie chez l'embryon, son développement considérable chez le fœtus; et chez l'adulte, la structure restée embryonnaire de ses capil-

laires sont les preuves de l'intensité des échanges osmotiques qui se produisent dans le foie à tous les âges de la vie.

(2) *Des preuves physiologiques:* *

(a) Le foie fabrique les divers éléments qui constituent la bile; la cellule hépatique, grâce surtout à son noyau, forme les acides et les sels biliaires aux dépens des diverses substances quaternaires, transforme l'hémoglobine en bilirubine (pigment du foie sain, l'urobiline étant le pigment du foie malade) et met le fer en liberté=(*Cholopoièse*).

(b) Aux dépens des hydrocarbures et même des albuminoides apportés par la veine porte, le foie fabrique le glycogène: ce glycogène est ensuite déversé dans le sang et est transformé ultérieurement en sucre nécessaire à la nutrition des éléments: la cellule hépatique est ainsi le grand régulateur de la chaleur animale =(*Glycopoièse*).

(c) Avec les produits de désassimilation des matières azotées (Brouardel) et par la décomposition des sels ammoniacaux, le foie forme l'urée, dont la quantité varie avec la plus ou moins grande activité de la glande hépatique=(*Uropoièse*).

(d) Enfin, le foie arrête et détruit en partie les substances toxiques exogènes (poisons minéraux, alcaloides) ou nées dans l'organisme par suite des fermentations intestinales ou des désassimilations organiques. Il a également une fonction d'arrêt et de destruction contre les microbes qui lui sont apportés par la veine porte.

Il y aurait encore lieu de considérer l'action du foie sur les graisses qu'il forme aux dépens des sucres, mais qu'il ne laisse accumuler qu'à l'état pathologique*, l'action hématopoiètique du foie chez le fœtus et dans quelques états pathologiques, son rôle de destructeur des globules rouges à l'état normal chez l'adulte.

Toutes ces fonctions du foie sont solidaires les unes des autres.

(3) *Des preuves cliniques.* "La palpation systématique du foie, l'analyse des symptômes subjectifs relevés dans les dyspepsies, les névropathies ou les maladies de la nutrition, prouvent l'origine hépatique d'un grand nombre d'entre elles. Et il n'y a pas simple coincidence; il y a bien relation de cause à effet; il y a identité du même principe morbide hépatique chez un même sujet, si variées que soient les maladies diathésiques qu'il puisse présenter. Cette identité est prouvée par les notions suivantes:" (Glénard)†: permanence, dans l'intervalle de ces maladies, des signes objectifs et subjectifs d'un principe morbide hépatique;—succession, suivant un ordre régulier durant la vie du malade et en rapport, soit avec l'âge du malade, soit avec la date de la première maladie, des diverses maladies diathésiques, parallèlement aux divers types objectifs du foie, lesquels se succèdent également suivant un ordre déterminé;—début, interruption ou terminaison, par une maladie proprement dite du foie de la série des maladies diathésiques, des maladies de l'hépatisme:—identité des causes de la première maladie diathésique du sujet et des causes des maladies du foie;—identité des indications thérapeutiques de la diathèse et des maladies du foie.

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* Voir Roger—Physiologie normale et pathologique du foie.

* Thèse de Melle Deflandre—Faculté des sciences de Paris. 1904.

† F. Glénard. Société médicale des hôpitaux de Paris. Séances des 9 et 23 novembre 1900.

(4) *Des preuves biochimiques:* Dans la plupart des cas de maladie par diathèse hyperacides, il nous a été donné de trouver dans la salive des éléments biliaires, normaux ou pathologiques. La présence de ces éléments biliaires est pour nous la preuve d'un mauvais fonctionnement de la glande hépatique.

Or, il est à remarquer que si toutes les fonctions du foie sont solidaires, chacune d'elles peut être atteinte à un degré divers dans une maladie donnée. C'est pour exprimer la prédominance de la lésion sur telle ou telle fonction que Glénard a proposé les termes de hépatisme biliaire, glycosurique, urique, pigmentaire. etc.

Mais il vit bientôt que deux des fonctions de la glande hépatique ont un caractère nosologique plus élevé que les autres: ce sont la fonction biliaire et la fonction urique. "La suprématie * de ce rôle se déduit d'abord d'une sorte d'antagonisme; car ces fonctions semblent rarement troublées au même degré; elle se déduit ensuite de la fréquence des troubles biliaires ou urique dans les maladies de l'hépatisme, de la précocité de leur manifestation, de leur persistance. toutes conditions d'où résulte une allure spéciale à chacune des maladies diathésiques, plus specialement afférentes à chacun de ces deux troubles du foie."

C'est pour cela que Glénard a proposé de distinguer deux genres d'hépatisme sous les noms *d'hépatisme cholémique et d'hépatisme uricémique.*

Ces deux genres de diathèse peuvent du reste se distinguer cliniquement par un certain nombre de signes. Le premier de ces signes est la sténose du colon: Ce symptôme n'existe jamais, sauf complexité etiologique, dans l'hépatisme uricémique, c'est-à-dire dans la goutte, le diabète, le rhumatisme chronique, la lithiase urique, l'asthme, l'obésité; au contraire, la sténose intestinale se rencontre assez souvent dans la cholémie (dyspepsie, neurasthénie, lithiase biliaire, entéroptose). Or, c'est dans le premier groupe que se trouvent la plupart des gros foies. et dans le second groupe, les foies déformés, abaissés, à ressaut derrière la côte.*

"En dehors du caractère distinctif éventuel tiré de la sténose du colon, j'ai signalé depuis longtemps dans l'hépatisme uricémique la fréquence de la gravelle et des selles abondantes qu'on ne rencontre au contraire pas dans l'hépatisme cholémique où la constipation est fréquente; la douleur à la pression de la fosse iliaque gauche dans le premier, de la fosse iliaque droite dans le second; et j'ajoutais combien une semblable dichotomie rappelle les vieilles distinctions entre le laxum et le strictum, entre la plethore et l'anémie, entre le tempérament sanguin et le tempérament bilieux . . . Il y aurait donc deux grands syndromes généraux, l'un dans lequel le foie—indépendamment bien entendu de ses caractères histologiques morbides—est plus ou moins hypérémié et l'intestin plus ou moins distendu, l'autre dans lequel le foie est plus ou moins olighémié et l'intestin plus ou moins sténosé." (Glénard.)

(a) Hépatisme Cholémique.

La fonction biligénique peut être troublée de diverses façons. Dans certains cas, elle semble exagérée: il y a hypercholie. Le plus souvent, toutefois, l'exagération de la fonction porte surtout sur la sécrétion des pigments biliaires: (hypercholie pigmentaire; cirrhose biliaire de Hanot)—il peut s'en suivre une véritable rétention avec diffusion des pigments dans l'organisme (*ictère pléiochromique de Stadelmans*). Mais le plus fréquemment, la résorption de la bile est due à une obstruction de ses voies d'excrétion (*lithiase biliaire* avec un stade initial; *cirrhose prélithiasique*).

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* F. Glénard: loco citato.

* F. Glénard. Séméiologie du foie. Lyon médical—1895.

La fonction biliaire peut au contraire être troublée dans le sens de la diminution de la sécrétion (*hypocholie*). Parfois même le foie est assez malade pour ne plus secréter de bile: il y a acholie; mais le plus souvent, ce sont seulement les pigments qui sont supprimés (*acholie pigmentaire*).

A côté de ces modifications portant sur la quantité des pigments sécrétés, il en est d'autres qui portent sur la qualité des pigments: l'urobiline alors apparait: nous n'insisterons pas ici sur ce point, l'urobilinurie se rencontrant surtout chez les uricémiques.

Du reste ces troubles quantitatifs dans la sécrétion biliaire suffisent pour entrainer *une série de phénomènes secondaires* qui rentrent dans le syndrome cholémique.

Chez les cholémiques, les troubles qui dominent sont d'ordre digestif et d'ordre nerveux.

Du côté du tube digestif; on note l'existence fréquente de vomissements alimentaires muqueux, bilieux, (dyspepsie); souvent aussi, il se produit des modifications de la digestion intestinale, modifications qui se traduisent tantôt par de la constipation (due à l'insuffisance de la sécrétion biliaire), tantôt par de la diarrhée.

Les phénomènes nerveux sont extrêmement fréquents dans les autointoxications d'origine hépatique. Ils peuvent se traduire par de la céphalalgie, des migraines et diverses psychopathies.* Hystérie (suggestionnabilité, accusations mensongères, hallucinations auditives, visuelles, ...). Phobies. Agoraphobie. Aboulis. Vesanies.

Enfin, chez les cholémiques, on peut observer divers symptômes cardiaques (cardiopathies) se traduisant par des palpitations.

(b) Hépatisme Uricémique.

L'hépatisme uricémique correspond à l'ancien arthritisme de Bazin, aux maladies par ralentisement de la nutrition de Bouchard.

Le trouble chimique dominant réside ici dans l'incomplète réduction des acides provenant de la destruction des matières azotées, des matières grasses et des matières sucrées.

La destruction de la matière albuminoide aboutit à la production de quatre ordres de corps:

(1) Des composés azotés: Les acides urique; hippurique; oxalurique.

(2) L'acide lactique et ses dérivés.

(3) La cholestérine et les acides gras volatils: Les acides caprylique; caproique; valérique; butyrique; propionique; acétique; oxalique.

(4) Le soufre mis en liberté au moment du dédoublement des albuminoides.

La destruction des matières grasses entraine la formation de glycérine et d'acides gras.

La glycérine en s'oxydant forme de l'eau et de l'acide carbonique.

Les acides gras: Stéarique; oléique; palmitique, donnent par dérivation les acides caproique; valérique; formique; oxalique.

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* Voir GLÉNARD. Progrès médical No. 6, février 1902.

L'amidon passe à l'état de dextrine et de glucose, celle-ci engendrant les acides lactique; butyrique; acétique; oxalique.

Les seules données que l'on possède à l'heure actuelle sur la genèse et sur les procédés de formation de ces divers acides sont les suivantes: Les acides lactique; butyrique; propronique; acétique; formique, peuvent se former dans l'estomac aux dépens du glucose.

L'acide caproique peut venir de la leucine, dérivé des peptones, par l'action du suc pancréatique.

L'acide valérique est issu d'un valériamide signalé dans le suc pancréatique par Gorup-Besanez.

L'acide acétique peut dériver du glycocolle du foie.

Kuhne, par expérimentation, a pu reproduire tous ces acides directement en faisant agir le chromate de potasse et de l'acide sulfurique sur les matières albuminoides.

Dans l'organisme, ces acides sont le résultat d'oxydations successives. Les uns sont brulés en totalité et ne s'éliminent pas en nature à l'état normal.

Les autres sont en partie brulés, en partie éliminés.

La peau élimine les acides formique; acétique; butyrique.

L'intestin élimine les acides butyrique; acétique; cholalique (dérivé des acides biliaires).

Les urines éliminent les acides urique; hippurique; oxalurique; phénique; succinique; oxalique.

Lorsque les acides sont produits en trop grande abondance ou que leur destruction, leur élimination est entravée, il en résulte un état dyscrasique caractérisé par une diminution des échanges organiques généraux.

Cette insuffisance de la combustion peut porter soit sur la totalité des principes immédiats, circulants ou fixes, soit sur ces principes pris isolément: l'arrêt dans l'oxydation des graisses mène à l'obésité; l'insuffisante combustion du sucre cause le diabète; l'insuffisance de la combustion des matières protéiques provoque la gravelle urique, la goutte.

Or, nous l'avons vu (voir page 316) le foie joue précisément le principal rôle dans les transformations ultimes que subissent les matériaux organiques avant d'être éliminés, et précisément encore, le foie jouit de trois fonctions distinctes portant: la première et la plus importante sur la désassimilation des substances azotées, la seconde sur l'assimilation et la réduction finale des sucres, la troisième sur la formation des graisses. (Voir page 318) Si cette dernière fonction n'est pas encore assez différentiée, pour être envisagée à part, il n'en est pas de même, nous semble-t-il, des deux autres fonctions, si bien qu'on peut à notre avis, un peu schématiquement sans doute, considérer deux groupes de maladies par uricémie:

(1) *Le groupe uricémique vrai,* dû avant tout à l'insuffisante élimination des matières azotées. Nous y rattachons l'obésité (formation des graisses en excès) la phosphaturie acide (qui est causée du reste par une insuffisance de l'élaboration des matières protéiques), enfin certains troubles hématopoiétiques.

(2) *Le groupe glycosurique,* dû avant tout à la mauvaise utilisation des matières sucrées et qui comprendra: Le diabète; la dyscrasie due à l'acide lactique; l'oxalémie.

Nous avons vu en effet que l'acide lactique et l'acide oxalique étaient avant tout formés par la décomposition des matières sucrées.

Etant donné la solidarité des fonctions du foie, nous ne nous étonnerons pas de rencontrer chez un malade diabétique par exemple les signes de l'insuffisante combustion des matières azotées et inversement.

Notre division est fatalement un peu schématique. Nous la croyons toutefois capable d'éclaircir l'exposé des différents types salivaires chez les uricémiques.

I. Groupe Uricémique Vrai. (Type goutteux).

Dans ce groupe, nous faisons rentrer, en dehors de la goutte et de ses diverses manifestations cutanées (tophus) articulaires, viscérales, et de l'obésité: Des *dermatites*—eczéma, prurigo, prurit cutané, sebarhée. Des *troubles pulmonaires*—asthme. Des *troubles circulatoires*—anémie des goutteux; chlorose; anémie pernicieuse [*]; hémorrhoides; artériosclérose. Des *troubles gastriques*—dyspepsie flatulente; gastralgie, urémie gastrique; hyperchlorhydrie. Des *troubles hépatiques*—gastro-hépatite (précirrhose de Glénard); gastro-colite, cirrhose atrophique de Laennec. Des *troubles urinaires*—albumine; gravelle. Certaines *migraines*.

Enfin, nous avons remarqué que les malades présentant un sarcome avaient le même biochimisme que les uricémiques vrais. Aussi faisons nous rentrer le sarcome dans la diathèse uricémique.[†]

Les maladies répondant à l'état virtuel de la diathèse uricémique vraie sont: la précirrhose, le dyspepsie prégoutteuse, migraines, constipation, chlorose, anémies.

Les maladies répondant à l'état réel de la diathèse uricémique vraie sont: (1) La goutte vraie. (2) Les maladies paragoutteuses—asthme, eczéma, etc.

II. Groupe Glycocémique.

Nous avons divisé ce groupe en trois sous-groupes: (a) *Diabète vrai, diabète gras des arthritiques* et ses diverses manifestations. Nous ne saurions les citer ici sans sortir du cadre de notre sujet.

(b) *Dyscrasie acide par acide lactique.* Cette dyscrasie se traduit par des infections gastro-intestinales (ainsi dans le rachitisme), des troubles dans la structure des os (ostéomalacie), de la fatigue musculaire, de l'impuissance. Nous n'avons pas établi de types salivaires répondant à ce groupe.

(c) *Dyscrasie oxalémique.* C'est la dyscrasie qui caractérise par excellence le neuro-arthritisme.

Elle comprend surtout des troubles articulaires. (Rhumatisme vrai, polyarthrite déformante, arthrite sénile, rhumatisme musculaire) et des troubles névropathiques.

Ces troubles affectent parfois la forme psychopathique (neurasthénie); ils peuvent se présenter sous forme de migraines, de spasmes, de tics douloureux.

Mais, le plus souvent, il s'agit de névralgies à sièges divers (facial, scapulodynie, brachial, plexus lombaire, honteux, sciatique . . . .).

Dans l'oxalémie, nous faisons rentrer le carcinome, nos études biochimiques nous ayant montré l'abondance de l'acide oxalique chez les carcinomateux. Sans vouloir développer cette idée qui nous est personnelle, nous ferons remarquer qu'elle concorde avec les études de Brault qui montrent qu'une tumeur est d'autant plus maligne qu'elle contient davantage de glycogène.

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[*] Nous ne voulons pas prétendre ici que toutes les chloroses, toutes les anémies pernicieuses, relèvent du syndrome uricémique, mais seulement que les cas de ces maladies que nous avons observés se sont présentés chez des uricémiques.

[†] Nous avons fait de longues études sur le biochimisme des sarcomateux et des carcinomateux. Nous avons l'intention d'en faire le sujet d'un travail spécial. C'est pourquoi nous n'insistons pas davantage ici sur cette question.

(c) Hépatisme Mixte (cholémique et uricémique).

Enfin, nous l'avons vu, les fonctions du foie sont solidaires les unes des autres. Il y aura donc des états mixtes pouvant relever de toutes les classes d'hépatisme que nous avons signalées.

Ainsi on pourra avoir:

Un goutteux { Diabétique
Oxalémique

Un goutteux { Cholémique
Uricémique, etc.

Ces états chimiques mixtes ne font du reste que confirmer ce que nous enseigne la clinique. Il est de règle, dans une même famille, de voir alterner les divers troubles cholémiques ou uricémiques de la diathèse hyperacide. Ce fait est trop connu pour que nous insistions davantage.

Dans la *diathèse mixte*, cholémique-uricémique, nous envisagerons surtout les maladies psychonévropathiques (névroses): Hystérie. Chorée. Éclampsie. Épilepsie.

En résumé, nous aurons à envisager successivement les groupes suivants de maladies:

I. Maladies avec hypoacidité organique.
= LYMPHATISME.
II. Maladies avec hyperacidité organique.
= HÉPATISME.
(A) Hépatisme cholémique.
(B) Hépatisme uricémique.
I. Groupe uricémique vrai.
II. Groupe glycocémique: Diabète; acide lactique; oxalémie.
(C) Hépatisme mixte.

CHAPITRE II.

Des caractères organoleptiques, chimiques, microchimiques de la salive normale et pathologique.

(A) GÉNÉRALITÉS.

Dans nos analyses, nous n'avons pas envisagé la sécrétion de telle ou telle glande salivaire, mais la salive mixte, c'est-à-dire la totalité du liquide sécrété par les glandes de la cavité buccale.

Nous considérons comme normale la salive d'un homme adulte bien portant. La salive de l'enfant, la salive du vieillard diffèrent en effet de la salive de l'adulte.

La salive physiologique type résulte de l'état d'équilibre des nombreux facteurs qui constituent la salive. Cet état d'équilibre physiologique est très difficile à déterminer, étant donné la multiplicité des corps qui entrent dans la composition de la salive. Aussi peut-on dire que la salive véritablement physiologique est l'exception, la salive pathologique la règle.

Toutefois, nous ne considérons comme vraiment pathologiques que les salives s'écartant du type normal d'une façon évidente.

La valeur de l'analyse de la salive mixte comme élément de diagnostic des états dyscrasiques est basée sur trois ordres de constatations analytiques:

(1) *Analyse des caractères organoleptiques.* Suivant qu'un individu est

normal ou diathésique, la quantité, la coloration, l'aspect, la transparence, la consistance, l'odeur, la saveur de la salive varient.

(2) *Analyse des caractères chimiques.* Suivant qu'un individu est diathésique ou non, la salive a une réaction variable au papier de tournesol; elle peut être neutre, alcaline, amphotère ou acide.

Suivant qu'un individu est ou non diathésique, la composition chimique de la salive varie.

Les éléments normaux de la salive peuvent différer en quantité absolue, et en quantité relative les uns par rapport aux autres. Des éléments anormaux peuvent apparaître. Ces différents états chimiques salivaires sont décélés par des variations dans les réactions normales de la salive. En comparant les différentes variations obtenues avec les divers réactifs dans une salive donnée, on peut établir la formule chimique approximative de cette salive.

(3) Enfin par le microscope et par le micropolariscope, il est possible de déterminer les principes histochimiques contenus dans la salive et d'étudier leurs variations (acides conjugués ou libres, sels alcalino-terreux, éléments biliaires, pigments biliphéiques et hémaphéiques, alcaloides, leucomaines ou ptomaines).

(B) ÉTUDE DES CARACTÈRES ORGANOLEPTIQUES.

Nous avons à envisager ici les différents caractères suivants:

(1) *Quantité:* Polysialie; normale; oligosialie; asialie.

(2) *Densité.*

(3) *Coloration:* Coloration primitive (incolore; blanchâtre; grisâtre). Colorations secondaires.

(4) *Aspect:* Limpide; opalescent; louche; boueux. *Transparence:* Translucide; semilucide; opaque. *Consistance:* Fluide; filandreuse; spumeuse; glaireuse; visqueuse.

(5) *Odeur:* (Primitive) Modérée; aliacée; vireuse; bilieuse; éthérée; acétonique. (Secondaire) Nauséabonde.

(6) *Saveur:* Insipide; fade-salée; amère; sucrée; métallique.

I. Quantité.

La quantité de la salive sécrétée par l'homme en 24 heures est difficile à évaluer. Elle parait être de 500 à 1200 c. c. (Herter).

La sécrétion est continue; mais elle augmente au moment des repas, sous l'influence d'excitations directes et reflexes. D'après Fueck, la quantité sécrétée au moment des repas serait de 250 à 750 gr.

Dans l'intervalle des repas, la sécrétion serait presque uniquement due aux glandes muqueuses. Gorup-Besanez estime que 100 gr. de glandes salivaires furnissent en moyenne 1300 gr. de salive avec 63 de principes solides.

Pratiquement, nous avons toujours déterminé la quantité de salive de la façon suivante: Nous faisons ouvrir la bouche du malade pendant cinq minutes en lui recommandant de ne faire aucun mouvement de déglutition. Nous le surveillons à ce point de vue (mouvement d'élévation du larynx pendant les mouvements de déglutition). Au bout de cinq minutes, nous recueillons à l'aide d'une pipette la quantité de salive accumulée et nous en dosons le volume.

Normalement, la quantité de salive recueillie pendant ce temps est assez variable. Nous pouvons observer en dehors d'une quantité moyenne, normale, idéale, de la polysialie, de l'oligosalie, de l'asialie.

Pathologiquement, la plupart des stomatites entraînent une salivation abondante: ainsi la stomatite mercurielle. Certains états nerveux amènent une sialorhée permanente (idiots, dégénérés) ou transitoire (épileptiques pendant leurs crises). Dans la diathèse hypoacide il y a toujours salivation abondante.

Au contraire, dans les maladies fébriles, la sécheresse de la bouche est un des premiers signes dont se plaignent les malades.

Dans le diabète, la salive est rare.

II. Densité.

La densité de la salive varie normalement de 1004 à 1009. La recherche de la densité, demandant une assez grande quantité de salive, ne peut pas toujours être faite en pratique. Du reste, elle ne donnerait pas de résultats bien appréciables.

III. Coloration.

La salive fraîche peut être incolore, blanchâtre, grisâtre.

La salive normale est incolore, de même que la salive des hypoacides et des neuro-arthritiques (rhumatisants oxaluriques). La salive des cholémiques, des hépato-uricémiques, des diabètiques est grisâtre.

En dehors de ces colorations primitives, des colorations secondaires peuvent se développer au bout d'un certain temps dans la salive conservée en flacon bouché.

Certaines substances organiques, incolores par elles-mêmes, sont en effet susceptibles, sous l'influence d'oxydations ou de fermentations ammoniacales, de donner naissance à des produits colorés. Ces phénomènes de coloration secondaire se rencontrent dans les salives qui contiennent des éléments biliaires.

Pour examiner la coloration d'une salive, nous la plaçons dans un verre à cristallisation et nous l'observons en employant une lumière oblique de haut en bas, ce qui permet de voir s'il y a à la surface une couleur irisée (indice pigmentaire).

Les colorations qui peuvent se produire sont les suivantes:

Pigments biliaires normaux.

Colorations.	Pigments occasionnant cette coloration.
Verdâtre	biliverdine.
Jaunâtre	biliflavine.
Vert noirâtre	biliprasine.
Bleuté	bilicyanine.
Brunâtre	bilifuschine.
Brun foncé	bilihumine.
Rouge	bilirubine.

Pigments anormaux.

Jaune doré	urobiline.
Noir	mélanine.

Toutes ces colorations sauf le brun n'affectent pas la transparence ni la limpidité de la salive. Les salives colorées en rouge, jaune d'or, vert, noir, . . . ne précipitent pas. Elles présentent cette particularité intéressante d'être dichroites, c'est-à-dire qu'elles donnent des tons variables suivant qu'on les regarde par transparence ou par réflexion.

Dans les salives qui prennent les tons brun clair ou brun foncé (bilihumine, bilifuschine) les matières colorantes se séparent et se précipitent sur les parois du flacon. Si l'on transvase la partie liquide de la salive, on constate qu'elle est claire.

A quelles affections équivalent cliniquement ces colorations?

Pigments dominants.	Couleur.	Maladies où on rencontre cette coloration.
	Normaux. (*Uricémique*).	
Biliverdine	Verdâtre	Cholosialie: goutte eczéma.
	Normaux. (*Cholémiques*).	
Biliflavine	Jaunâtre	Cachochimisme.
Biliprasine	Vert noirâtre	?
Bilicyanine	Bleuté	Psychopathie, indicanurie.
Bilifuschine	Brunâtre (avec précipité)	Chorée.
Bilihumine	Brun foncé (avec précipité)	Hépatique cirrhotique (cirrhose de Hanot).
Bilirubine	Rouge	Psychopathies hépatiques.
	Anormaux. (*Uricémiques*).	
Urobiline	Jaune doré	Névropathies arthritiques; rhumatisants; oxalémiques.
Mélanine	Noir	Cancer.

IV. Aspect, Transparence, Consistance.

La salive peut avoir un *aspect:* Limpide; opalescent; laiteux; louche; boueux. La *transparence* peut être: Complète = translucide; demi complète = semi-lucide; nulle = opaque. Au point de vue de la *consistance* la salive peut être: Fluide; filandreuse; spumeuse; glaireuse; visqueuse.

Cette variabilité de l'aspect, de la transparence, de la consistance de la salive ne peut s'expliquer que par la variation pathologique de tel ou tel principe azoté (mucine, albumine, sucre).

Les éléments physiologiques normaux qui déterminent la consistance de la salive sont: (1) La sialoine ou ptyaline, principe diastasique. (2) Le glycogène, amidon animal. (3) La mucine (matière spumeuse). (4) Les sels (chlorures, etc.).

Suivant que tous ces principes sont moins abondants ou plus abondants qu'a l'état normal ou que des éléments pathologiques apparaissent (éléments biliaires) la consistance de la salive varie.

A l'état normal, la salive mixte est un liquide opalescent semi-transparent, spumeux, un peu filant, laissant déposer par le repos un sédiment blanchâtre séparable par filtration; la réaction caractéristique est la réaction glycogénique.

Pathologiquement, la salive peut présenter des variations de consistance momentanées ou permanentes.

Nous n'insisterons pas ici sur les variations momentanées que peut présenter la consistance de la salive. Les phénomènes émotionnels rendent la salive plus épaisse: les orateurs ont la bouche pâteuse; les gens qui se mettent en colère voient souvent leur salive devenir spumeuse. De même la salive est spumeuse après les crises nerveuses (hystérie et surtout épilepsie).

Nous envisagerons plus longuement les variations permanentes de la consistance de la salive dans les états dyscrasiques.

Nous avons dressé à ce sujet le tableau suivant:

SALIVE.

Coloration Primitive.	Aspect.	Transparence.	Consistance.	Corps chimiques déterminant ces caractères.	États dyscrasiques correspondants.
Incolore.	Limpide.	Transparente.	Fluide.	Sels de sodium et NH^4Cl.	Hypoacides.
Incolore.	Limpide.	Transparente.	Fluide.	Chlorures alcalins.	Neuro arthritiques (oxaluriques rhumatisants).
Grisâtre.	Louche.	Semi-transparente.	Fluide.	Eléments biliaires.	Hépato cholémiques.
Grisâtre.	Opalescent.	Semi-transparente.	Filandreuse.	Albumine en excès.	Hépato uricémiques (goutteux).
Grisâtre.	Boueux.	Opaque.	Glaireuse.	Fibrine.	Hépato uricémiques (catarrhal).
Grisâtre.	Louche.	Opaque.	Visqueuse.	Glucose.	Catarrhedes albumineriques diabétiques.

Du reste la consistance d'une salive varie si on laisse cette salive en flacon pendant quelque temps.

Dans les salives renfermant de la cholestérine par exemple, il se forme, au bout d'un certain temps de flacon, une couche graisseuse blanc crêmeux qui surnage au liquide. Ce caractère se rencontre souvent dans la salive des diabétiques uricémiques.

Les salives, si consistantes soient-elles, laissées en flacon, se divisent bientôt en deux parties: une partie liquide et une partie solide. Cette partie solide constitue les sédiments.

A l'état normal, nous l'avons vu, les sédiments existent en petite abondance et ont une coloration blanchâtre.

Nous savons également que chez les hépatiques ils peuvent prendre une coloration brunâtre, chez les cancéreux une teinte noire. . . . .

La matière sédimenteuse, composée de cellules épithéliales, de produits fibrineux (zoogommites) se dépose en quelques heures.

Quant aux éléments salins cristallisables, ils se forment au milieu du liquide en état de stagnation. Ces sels ne sont cristallisés qu'au bout de quelques jours ou même de quelques semaines.

Nous reprendrons l'étude des sédiments à propos de l'analyse microchimique.

V. Odeur.

Normalement, la salive n'a pas d'odeur.

Immédiatement après avoir recueilli la salive, on peut constater, dans certaines intoxications, une odeur spéciale (odeur aliacée dans l'intoxication phosphorée). Dans les états chroniques, on peut constater une odeur vireuse (cachochymisme), une odeur bilieuse (éléments biliaires), une odeur éthérée (diabétiques), une odeur acétonique (coma diabétique, alcoolisme).

Secondairement, des odeurs peuvent se développer dans la salive conservée en flacon fermé. Ces odeurs nauséabondes se développent sous l'influence des fermentations butyriques et lactique, de préférence chez les hypoacides (lymphatiques) et dans les salives bilieuses (cholémiques).

Ces fermentations et par conséquent ces odeurs ne se produisent pas chez les hyperacides, par exemple chez les rhumatisants oxalémiques.

Cette différence tient à ce que la salive des hyperacides contient seulement des pigments biliaires, éléments non odoreux; tandis que la salive des cholémiques contient tous les principes de la bile (éléments odoreux).

VI. Saveur.

A l'état normal, la salive est insipide. Dans différents états pathologiques, la salive prend une sapidité spéciale.

Dans certaines intoxications, (mercure, cuivre) la salive prend un goût métallique.

Elle est salée quand les sels chlorurés sont très abondants.

Elle est amère lorsque les éléments biliaires prédominent.

Cette saveur amère, persistante, serait due d'après Murchison, à l'acide tairiocholique.

Elle est sucrée dans le diabète. Elle est acide lorqu'il y a trouble de fermentation.

Chez les arthritiques, on a signalé un goût métallique de la salive. Nous pensons que ce goût est produit par le dédoublement de la créatine (créatine, sarcosine, urée). On a signalé dans la salive la présence de l'urée. Or, la sarcosine, principe de réduction de la série créatinique (des leucomaines) a un goût doux et faiblement métallique. A l'état acide, elle devient l'acide sarcolotique ou paralactique (isomère de l'acide lactique)—(hypothèse à contrôler).

Conclusions.

Tels sont les caractères organoleptiques que nous avons recherchés dans la salive. Nous avons essayé, pour chacun d'eux, de montrer à quels phénomènes cliniques répondent leurs variations.

Avec ces notions, nous pouvons dresser le tableau des caractères organoleptiques de la salive chez les hypoacides, les cholémiques, les hyperacides goutteux, diabétiques, oxalémiques. Ainsi:

La salive des hypoacides: Quantité = abondante. Coloration primitive = incolore; pas de coloration secondaire. Aspect = limpide. Transparence = complète. Consistance = fluide (par sels de sodium et $NHCl$). Odeur primitive = nulle; secondaire = nauséabonde. Saveur = (?).

La salive des cholémiques: Quantité = variable. Coloration = (primitive) grisâtre, (secondaire) jaunâtre = cachochymisme; vert noirâtre; bleuté = psychopathie; brunâtre (cristallisations) = chorée, ictère (Hanot); rouge = psychopathie. Aspect = limpide. Transparence = complète. Consistance = fluide (par éléments biliaires). Odeur = (primitive) bilieuse; (secondaire) nauséabonde. Saveur = amère.

La salive des uricémiques vrais, type goutteux: Quantité = variable. Coloration = (primitive) grisâtre, (secondaire) verdâtre = goutte, eczéma; noir = cancer. Aspect = opalescent. Transparence = semi-transparente. Consistance = filandreuse (albumine en excès). Odeur = (primitive) nulle; (secondaire) nulle. Saveur = métallique.

La salive des diabétiques: Quantité = très faible. Coloration = (primitive) grisâtre, (secondaire) nulle. Aspect = louche. Transparence = opaque. Consistance = visqueuse (glucose). Odeur = éthérée; parfois acétonique (glucose). Saveur = sucrée.

La salive des oxalémiques: Quantité = variable. Coloration = (primitive) incolore; secondaire = jaune doré. Aspect = limpide. Transparence = transparente. Consistance = fluide. (par chlorures alcalins). Odeur = (primitive) inodore; (secondaire) inodore. Saveur = salée.

La salive des malades à hépatisme mixte: Quantité, variable; Coloration, variable; Aspect, variable; Transparence, variable; Consistance, variable; Odeur, variable; Saveur, variable.

(C) ÉTUDE DES CARACTÉRISTIQUES CHIMIQUES.

Notre plan d'exposition sera très simple. Nous passerons d'abord rapidement en revue les différents corps qui ont été trouvés dans la salive, tant normale que pathologique. Nous décrirons ensuite notre méthode d'analyse pratique de la salive, montrant la valeur de chacune de nos réactions au point de vue du diagnostic des états morbides dyscrasiques. Enfin, nous comparerons les résultats que donne cette méthode au point de vue du diagnostic des affections diathésiques avec ceux que fournit l'urologie.

I. De la Composition Chimique de la Salive Mixte.

Comme la salive mixte est un mélange de produits de sécrétion des glandes salivaires et de ceux de la muqueuse buccale, il s'en suit qu'elle doit renfermer à la fois les principes constitutifs de la salive et ceux du mucus; l'analyse chimique nous montre en effet que ce liquide contient:

(A) *Des principes constitutifs* constants: Organiques. Inorganiques: métalloides; métaux.

(B) *Des principes n'existant pas d'une façon constante:* (1) Éléments de désassimilation puisés dans l'organisme même. (2) Substances introduites dans l'organisme et éliminées par la salive.

Nous passerons tour à tour en revue ces différents principes, en insistant surtout sur le second groupe (éléments inconstants). Nous renvoyons, pour l'étude plus complète du premier groupe aux traités de chimie physiologique (Gorup-Besanez, Arthus, ...)*

(A) Principes Constitutifs Constants.

Nous résumerons d'abord en un tableau les éléments principaux trouvés dans la salive mixte en indiquant les doses auxquelles on les a trouvés. Nous ferons remarquer que les analyses qui suivent ne peuvent avoir en aucune façon la prétention d'indiquer la composition de la salive d'une manière absolue. Elles ont été faites par divers auteurs, dans des conditions très différentes; par conséquent, elles ne donnent qu'une idée très approximative de la composition de ce liquide. (Voir le tableau ci-dessus.)

Principes constitutifs dans 1000 parties.

	Simon.	Berzélius.	Frérichs.	Jacubowitz.	Lehmann.	Hammerbacher.
Eau	991,22	992.9	994,10	995,16	994,06	994,203
Matières solides	8,78	7,1	5,90	4,84	5,94	5,790
Ptyaline	4,37	2.9	1,42	1,34	....	2,202
Mucus et épithéliums	1,40	1,4	2,13	1,62	....	1,390
Corps gras	0.32	....	0,07	....	....	....
Sulfocyanures	....	....	0,10	0,06	0,07	....
Extrait aqueux et sels	2,45	....	....	....	....	....
Extrait alcoolique	....	0,09	....	....	....	....
Chlorures alcalins	....	....	....	0,84	....	....
Phosphate de sodium	....	....	....	0,94	....	....
Sulfate de sodium	....	....	....	traces	....	....
Chaux et matières organiques combinées	....	....	....	0,03	....	....
Magnésie et matières organiques combinées	....	....	....	0,01	....	....
Phosphate terreux et oxyde de fer	....	....	....	....	....	....
Poids total des sels	....	....	....	1,82	....	2,205

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* Nous avons du reste étudié très longuement la composition de la salive dans notre précédente communication au Congrès de Paris, 1900. Nous croyons toutefois utile de revenir sur ce point.

(a) PRINCIPES CONSTITUTIFS CONSTANTS ORGANIQUES.

(1) *Mucine.* La mucine salivaire signalée par Longet, Arthus, Frey . . . ., provient surtout de la sécrétion de la glande sous maxillaire. Isolée, c'est une substance blanche, filamenteuse et gluante. Chimiquement, elle doit être considérée comme un glycoside azoté (amylo-dextrine). Elle donne la réaction de Miller et la réaction xantho-protéique. Bouillies avec l'acide sulfurique ou l'acide chlorhydrique dilués, les solutions de mucine salivaire sont dédoublées en une substance albuminoide et un hydrate de carbone, capable de réduire la liqueur cupro-potassique de Fehling: cet hydrate de carbone $C^{12}H^{20}O^{10} + 2H^{2}O$ est la gomme animale de Landinehr. (Pour de plus amples détails sur les propriétés chimiques, le mode de dosage et de préparation de la mucine, voir Arthus —Chimie physiologique, pages 249-251).

La mucine salivaire est précipitable dans un milieu légèrement acide, par combinaison avec l'ammoniaque qui en fait un amidiaque, se déposant sur les dents. Cette réaction nous explique pourquoi le principe glyco-mucique ne précipite pas chez les hypoacides, tandis qu'il forme sur les dents des hyperacides des dépôts de consistance et de coloration variables, (noire chez les rhumatisants), fermentescible (goutteux) ou non (rhumatisants). Nous avons étudié tous ces points dans notre Communication au Congrès de 1900. (Voir pages 61 à 64.)

(2) *Albumine.* La salive contient toujours une très petite quantité d'une substance albuminoide, coagulable par la chaleur, appartenant au groupe des globulines.

Cette substance existe dans la salive en très petite quantité. Elle a été signalée par Arthus, Jacubowitz, Vulpian, Pouchet.

Selon Vulpian, la quantité d'albumine augmenterait dans la salive des brightiques albuminuriques. Ainsi, chez trois individus dont l'un était sain, Vulpian a trouvé les chiffres suivants:

	Mucine Per cent.	Albumine. Per cent.
Homme sain	0,320	0,05
Albuminerie d'origine cardiaque	0.45	0,145
Néphrite parenchymateuse.	0,253	0,182

Le fait a été confirmé par Pouchet, qui donne des chiffres encore plus élevés.

(3) *Ptyaline.* La ptyaline, principe diastasique de la salive a été signalée par Gorup-Besanez, Arthus, Von Jaksch, Frey. Nous n'avons pas l'intention d'étudier ici comment la ptyaline saccharifie l'amidon. (Voir Chimie physiologique, pages 253-258—Arthus.) Nous rappellerons seulement que dans notre précédent travail, (voir pages 43-49) nous avons essayé de montrer que la carie dentaire chez les adolescents en parfait état de santé était peut-être due à une fermentation du glycogène par la salive.

Nous avons aussi montré comment se comportaient les anhydroses sous l'action des salives normale et pathologique. (Voir tableau, page 41, communication au Congrès de 1900.)

(4) *Corps gras.* Des matières grasses phosphorées, à l'état de traces, ont été signalées par Gorup-Besanez, Longet, Peters. Nous avons nous-même rencontré la lécithine dans la salive en faible quantité (Lécithine: $C^{44}H^{90}AzPhO^{9}$).

(5) *Glycogène.* Le glycogène est un élément constant de la salive, à qu'il donne sa consistance. Les principales propriétés du glycogène nous semblent pouvoir être résumées ainsi: Le gly-

cogène: (1) Donne une coloration opalescente. (2) Ne fermente pas avec la levûre de bière. (3) Hydrolyse en présence de la ptyaline pour former la dextrine et la glucose. (4) Est insoluble dans l'alcool, l'éther. (5) Prend la coloration brun acajou par le réactif de Gram. (6) Ne précipite pas le réactif de Nessler, ni ne subit pas de modification avec les alcalis caustiques en ébullition. (7) Ne prend pas de coloration par l'eau iodée. (8) Est précipité par l'alcool ainsi que la dextrine; la maltose ni la glucose ne précipitent pas par l'alcool.

(6) *Sulfocyanures.* Les sulfocyanures signalés par Eréviranius, Lehmann, Longet, Arthus, Gorup-Besanez, Gautrelet, ... se rattachent au groupe du cyanogène. Ils dérivent directement de l'acide sulfocyanhydrique ($CAzSH$). Les sulfocyanures d'alcalins, trouvés dans la salive, ont donc pour formule:

Sulfocyanure de potassium......	$CAzSK$
Sulfocyanure de sodium	$CAzSNa$
Sulfocyanure d'ammoniaque	$CAzS(AzH^4)$

Nous n'étudierons pas ici la façon dont on décelle chimiquement la présence des sulfocyanures dans la salive. (Voir Arthus, pages 252-253.)

Normalement, les sulfocyanures existent dans la salive mixte en très petite quantité, 0,008 per cent.

Cette quantité varie avec les états pathologiques.

Les hypoacides n'ont que des traces faibles de sulfocyanures salivaires. Les hyperacides, au contraire, en ont des traces variables, plus grandes dans l'état réel que dans l'état virtuel de leur diathèse.

Les rhumatisants en ont une quantité considérable, les goutteux une moins grande quantité, les phosphaturiques, encore moins.

Nous avons essayé de montrer, dans notre précédente Communication, l'influence de la richesse de la salive en sulfocyanures, sur l'évolution de la carie dentaire. (Voir pages 64-69.) Nous ne reviendrons pas sur ce sujet.

(7) *Ptomaines.* Le Professeur A. Gautier, dès 1881, a découvert l'existence des ptomaines dans la salive normale humaine. (*Journal d'anatomie et de physiologie*, 1881.) "L'extrait de salive humaine est toxique pour les oiseaux. D'autre part, si l'on reprend l'extrait soluble de la salive par un peu d'acide chlorhydrique étendu, puis par le réactif de Meyer, on obtient un précipité qui, recueilli, lavé et décomposé par l'acide sulfohydrique, donne une solution qui laisse déposer, par évaporation, de fines aiguilles microscopiques d'un chlorydrate soluble.

"Ce sel, séparé par l'alcool, de diverses impuretés, donne, avec le chlorure d'or et celui de platine, des cristaux solubles très altérables. La solution de chlorhydrate précipite immédiatement du bleu de Prusse par le mélange de ferricyanure de potassium et de perchlorure étendu . . . . . Le venin des serpents ne me parait donc différer de notre salive que par l'intensité de ses effets."

(b) PRINCIPES CONSTITUTIFS CONSTANTS INORGANIQUES.

Nous ne ferons que les citer:

(1) *Chlorures alcalins.* (Potassium, sodium, ammonium) ont été signalés par Rabuteau, Kuhn, Binet, Gorup-Besanez.

Les chlorures de potassium et de sodium existent en quantité assez considérable dans la salive et dans la sueur.

Dans les affections fébriles, les chlorures diminuent dans l'urine et ils en serait de même dans la salive et dans la sueur.

Ils sont particulièrement abondants dans la dyscrasie goutteuse (urieémie).

Le chlorhydrate d'ammoniaque n'existe guère que dans la salive des hépatiques diathésiques. On peut le caractériser chimiquement par le réactif de Nessler et par cristallisations microchimiques.

(2) *Sulfate* de potasse, signalé par Gorup-Besanez; de soude (traces).

(3) *Azotates,* signalés par Gorup-Besanez.

(4) *Phosphates* alcalins; alcalino-terreux (ammoniaco-magnésiens).

Ces différents phosphates ont été signalés par Jacubowitz, Rabuteau, Gorup-Besanez. Jacubowitz a trouvé 1 gr. par 1000 de phosphates alcalins et une petite quantité de phosphates terreux.

Le phosphate de fer a été trouvé par Kollmann, Jacubowitz; Binet n'a pu le déceler. Le fer ne parait du reste que difficilement dans la salive et toujours en petite quantité.

Les variations de quantité des phosphates alcalins et des phosphates alcalino-terreux sont assez intéressantes à étudier attendu qu'elles constituent la caractéristique dominante de la phosphaturie.

Les phosphaturiques sont de deux ordres. Chez les uns, la salive a une réaction acide ou amphotère. Il existe alors un excès de phosphate acide de soude. H^2NaPO^4. Chez les autres, la réaction de la salive est neutre.

Il existe surtout un phosphate neutre HNa^2PO^4.

(5) *Ammoniaque—Carbonate d'ammoniaque.* L'ammoniaque est un élément constant dans la salive. Il y est décélé par le réactif de Nessler. Il est particulièrement abondant chez les hypoacides, lymphatiques, tuberculeux, et se combine alors souvent au chlore des chlorures pour former des chlorhydrates.

Au contraire, l'ammoniaque est peu abondant dans la diathèse hyperacide.

Nous avons étudié dans notre précédente Communication (voir pages 70-72) l'influence des variations quantitatives de l'ammoniaque dans la salive sur la carie des dents.

(B) Principes N'existant Pas d'une Façon Constante.

(a) ÉLÉMENTS DE DÉSASSIMILATION PUISÉS DANS L'ORGANISME MÊME.

Nous les répartirons en deux classes: (1) Produits de sécrétion et de dédoublement intermédiaire. (2) Produits de la métamorphose régressive.

(1) *Produits de sécrétion et de dédoublement intermédiaires.*

Nous comprendons dans cette classe: (a) Les éléments biliaires; (b) Les hydrates de carbone.

(a) ÉLÉMENTS BILIAIRES.

Nous avons longuement insisté sur cette question dans notre dernière Communication (voir pages 48-58).

Pigments biliaires et acides biliaires:

A l'état normal, Gorup-Besanez semble admettre le passage de pigments biliaires dans la salive.

Contrairement à Wright, Hoppe-Seyler dit que le bilirubine ne parait pas passer dans la salive.

A. Gautier a vu le pigment biliaire apparaître dans la salive parotidienne d'un chien à qui l'on avait fait une injection de bile de bœuf dans la saphéne.

D'autre part, il déclare n'avoir pas vu le pigment dans la salive des ictèriques. Binet n'a jamais pu le décéler dans ce cas.

Cependant, il ne nous semble pas doureux que dans de nombreux états morbides hépatiques (cholémie, uricémie) les éléments biliaires passent dans la salive.

Nous avons déjà vu (voir coloration, odeur, page 327) quelles modifications la présence de la bile pouvait apporter aux propriétés organoleptiques de la salive. Nous ne reviendrons pas sur ce point.

Nous rappellerons seulement ici que, dans notre dernier travail, nous avons montré que la vertu antifermentescible de la biline, médiocre en solution alcaline est active en solution acide, et que par conséquent, la présence de la biline, (c'est-à-dire du cholate ou taurocholate de soude) dans la salive des hyperacides rendait les fermentations buccales de la glyco-mucine moins actives.

Nous avons attribué en grande partie à ce phénomène la raison de l'immunité ou de l'arrêt de la carie dentaire chez les hyperacides. (Voir pages 48-51.)

Urobiline. Dans notre dernier travail (page 57) nous avons également montré que l'urobiline pouvait apparaître dans la salive des hyperacides, en combinaison avec les sels d'ammoniaque et qu'on pouvait l'y décéler par le réactif de Nessler.

Cholestérine. La présence de cholestérine, corps gras, dans la salive, indique que la saponification des graisses par le cholate et le taurocholate de soude est inférieure à la normale, l'élément acide l'emportant sur l'élément base.

(b) CLASSE DES AMYLOSES.

Nous étudierons ici: Des dextrines: érythro-dextrines, achro-dextrines. La maltose, enfin, la glucose.

Les dextrines et la maltose n'existent dans la salive qu'à l'état pathologique; elles proviennent de la transformation du glycogène par la ptyaline en milieu acide. On ne les rencontre donc que chez les hyperacides.

Les *dextrines* ($C^6H^{10}O^5 + H^2O$) sont solubles dans l'eau (la solution aqueuse n'est pas opalescente) insolubles dans l'alcool. Elles réduisent la liqueur de Fehling; le pouvoir réducteur est faible. Elles ne fermentent pas la levure de bière. Les acides dilués, à l'ébullition, les transforment en maltose, puis en glucose.

Parmi les dextrines, les unes se colorent en rouge par l'iode-ioduré ou par l'eau iodée. On les nomme érythro-dextrines; les autres ne se colorent pas par ce réactif: on les nomme achro-dextrines.

La *maltose* $C^{12}H^{22}O^{11} + H^2O$ est soluble dans l'eau, soluble dans l'alcool absolu; c'est un sucre qui possède qualitativement toutes les réactions de la glucose en laquelle elle se dédouble.

$$C^{12}H^{22}O^{11} + H^2O + C^6H^{12}O^6 + C^6H^{12}O^6$$

Sucre dextrogyre, réducteur et fermentescible, la maltose a un pouvoir réducteur égal à 66, le pouvoir de la glucose étant égal à 100.

Glucose. Il existe de grandes divergences à ce sujet entre les auteurs.

Le passage du sucre dans la salive des diabétiques est nié par Claude Bernard, Pouchet. Il est admis par Lehmann, Nasse, Pavy Jordeo, Koch, Gorup-Besanez. Lécorché admet le passage du sucre dans la salive dans certaines conditions.

Nous avons nous-même constaté la présence de sucre dans la salive des diabétiques. La glucose prend par le réactif de Nessler, une coloration rouge qui vire au bleu grisâtre. (Michaels.)

(2) *Produits de la métamorphose régressive.*

(a) COMPOSÉS AMIDÉS, ACIDES AMIDÉS. URÉIDES.

La leucine, la tyrosine, déjà décélées dans la salive par Gorup-Besanez, ont été retrouvées dans plusieurs de mes analyses.

De même, j'ai pu trouver dans des salives pathologiques, la créatine, l'hypoxanthine, la xanthine.

L'acide urique n'existe pas dans la salive en tant qu'acide libre; mais l'urate de soude, ainsi que l'urate d'ammoniaque, se rencontrent fréquemment dans la salive des hyperacides.

L'urée a été signalée dans la salive par Pettenkofer, Picard, Rabuteau, Robin, Debove, Gorup-Besanez.

Les chiffres donnés par ces divers auteurs sont assez variables. (Voir notre précédent travail, pages 13-14.)

Par le microscope, j'ai pu constater dans la salive, des cristaux prismatiques à 4 ou 6 pans, caractéristiques de la taurine. Meissner n'a pas trouvé l'acide hippurique dans la salive, mais j'ai pu y décéler un hippurate de chaux.

(b) COMPOSÉS AZOTÉS INDIFFÉRENTS.

Dans ce groupe, il ne rentre guère que l'indican que j'ai pu décéler dans la salive de certains dyspeptiques cholémiques.

ACIDES ORGANIQUES NON AZOTÉES.

Je citerai ici l'acide propionique, l'acétone (chez les diabétiques—Meissner), l'acide succinique (déjà trouvé par Meissner et Shepard), le succinate d'ammoniaque (Gorup-Besanez).

J'ai exposé mes recherches au sujet de ces corps dans mon dernier travail (page 60).

Enfin, Gorup-Besanez a signalé la présence d'acide lactique dans la salive.

(b) SUBSTANCES INTRODUITES DANS L'ORGANISME ET ÉLIMINÉES PAR LA SALIVE.

(1) L'élimination par la salive des *principes métalloides,* chlore, iode, brome, introduits dans l'organisme, est un fait bien connu.

D'après Salkowsky, la salive serait une voie d'élimination élective pour les sels de potasse.

Le chlorate de potasse se montrerait dans la salive, d'après Rabuteau, en moins de cinq minutes après son absorption stomacale.

Le passage de l'iode et du brome dans la salive a été constaté par Claude Bernard, Vulpian, Binet, Gorup-Besanez.

Gorup-Besanez et Rabuteau, ont reconnu l'élimination des bromures et des iodures par la salive.

Les chlorates alcalins, les azotates, et, d'après Kuhne, les sels isomorphes aux chlorures, passent aisément dans la salive et leur élimination s'effectue aux dépens d'une quantité équivalente de chlore à laquelle ils se substituent.

Le phosphore, les hypophosphites peuvent être éliminés par la salive (Rabuteau) = (odeur aliacée de la salive).

On n'a pas pu décéler le passage dans la salive de l'arsenic, ni de l'antimoine.

Pouchet, à trois reprises, a pu décéler des traces de plomb dans la salive des saturniens.

Le mercure a été trouvé dans la salive par Gosselin, Rosbach, Byasson, Gorup-Besanez.

(2) *Parmi les composés organiques médicamenteux,* le salycilate de soude a été signalé dans la salive par Busch, Benoit, Mussy, Ory, Binet.

Hoppe-Seyler a constanté la présence du phénol.

Vulpian admet que le chloral s'élimine en partie par la salive.

II. Methode d'Analyse Pratique de la Salive Mixte.

Devant cette complexité chimique de la salive, comment pourrons-nous acquérir d'une façon simple, des données permettant un diagnostic sialologique?

Nous rechercherons d'abord la réaction de la salive au papier de tournesol, puis nous limiterons l'analyse chimique aux éléments physiologiques principaux, en ayant soin de déterminer, pour chaque réactif, tous les caractères de la réaction, caractères que nous indiquerons tout d'abord.

Les données ainsi obtenues, jointes aux données fournies par les caractères organoleptiques et l'analyse micropolariscopique, nous semblent suffisantes pour tirer des conclusions séméiologiques.

(A) CARACTÈRES GÉNÉRAUX DES RÉACTIONS.

La réaction est la manifestation de l'affinité chimique.

Le réactif est un corps capable de déceler un autre corps prenant part à une combinaison. Certains réactifs sont connus sous le nom de leur auteur.

Les réactions que l'on obtient avec un même réactif et une technique identique sont variables avec chaque salive, suivant qu'elle est normale ou pathologique.

Les réactions peuvent être positives ou négatives, régulières ou irrégulières (c'est-à-dire miscibles ou précipitées) immédiates ou médiates.

La coloration obtenue est variable. Plus la coloration est foncée, plus le principe chimique recherché est abondant dans la salive. L'état normal est représenté par une coloration donnée (média) pour chaque réactif.

Toute variation de coloration en plus (majeure) ou en moins (mineure) indique un état dyscrasique donné. On pourra donc établir une échelle chromatique avec signification clinique de chacune des couleurs trouvées.

(1) RÉACTIONS POSITIVES.

Trois cas peuvent se présenter:

(a) *Réaction régulière.* La réaction est miscible, à coloration immédiate, l'intensité de la coloration indiquant la valeur docémasique du principe chimique cherché.

(b) *Réaction irrégulière, première phase.* La réaction immediate détermine un précipité. La miscibilite est incomplète. Les colorations obtenues sont variables. La production de ces réactions irrégulières est due à la présence dans le liquide étudié, de sels acides ou alcalins, ainsi—

Les phosphates acides ou alcalins troublent par leur abondance, la réaction de l'ammoniaque.

(c) *Réaction irrégulière. deuxième phase.* La réaction est miscible; la coloration se fait normalement; puis, au bout d'un certain temps, elle vire à une autre couleur. Ce phénomène secondaire indique la présence dans la salive d'un second corps qui répond au même réactif que le corps habituellement cherché. (Nous verrons que la glucose offre une réaction de ce genre avec le réactif de Nessler.)

(2) RÉACTIONS NÉGATIVES.

Ces réactions sont la conséquence de l'absence du corps ordinairement décélé par le réactif, ou bien de ce que ce corps est masqué par d'autres principes chimiques docémasiquement supérieurs.

L'étude de ces cinq caractères de toute réaction chimique permet d'en arriver à des données assez précises.

Le rapport des données de plusieurs réactions entre elles et vis-à-vis de la normale, précise encore les résultats obtenus.

Prenons par exemple deux réactions, celle des sulfocyanures et celle de l'ammoniaque. A l'état normal, elles sont miscibles, immédiates et caractérisées par une teinte de même intensité.

On a affaire à une salive anormale lorsque l'une des réactions donne lieu à une coloration plus intense que l'autre ou bien qu'il se forme un précipité, ou que l'une des réactions est négative.

. . . .

Pour noter plus facilement ces différents caractères des réactions, nous avons adopté des signes conventionnels:

La normale est indiquée par......	1
L'égalité à la normale	=
L'infériorité	<1
La supériorité	>1
La miscibilité de la réaction	O
La précipitation	⊙
La puissance docémasique, quand elle est supérieure à la normale.	+ 1, 2, 3
La puissance docémasique, quand elle est inférieure à la normale.	— 1, 2, 3
L'absence du principe cherché....	*S*

Aussitôt que la salive est recueillie, nous recherchons sa réaction au papier de tournesol, puis nous faisons nos diverses réactions chimiques.

Une quantité constante de salive et une quantité constante de réactif sont nécessaires pour chaque réaction. Nous alignons, à la suite, sur une palette de faïence blanche, une série de fois deux gouttes de salive, puis nous ajoutons avec un compte goutte une goutte de réactif en le faisant tomber de 2 à 3 cm. de haut.

Lorsque la salive est très consistante, cette consistance est due, nous l'avons vu, aux matières albuminoides. Pour se débarrasser de celles-ci, on dilue la salive à examiner avec de l'eau distillée. On la chauffe pour fixer l'albumine, puis on filtre. On ramène ensuite la salive à son taux primitif; et on fait l'analyse chimique comme d'ordinaire.

RÉACTIONS SUCCESSIVES.

Nous les avons limitées à la recherche de corps peu nombreux; certains de ces corps se décèlent même par des particularités de réaction d'autres corps. (Recherche indirecte.)

(1) *Réactif de Nessler.* Le réactif de Nessler décèle l'ammoniaque (AzH^3) et le chlorhydrate d'ammoniaque(AzH^4Cl). Ses variations peuvent permettre de découvrir la surabondance des chlorures et la présence de sucre dans la salive. On peut encore, par le réactif de Nessler, déceler la présence d'urobiline et la présence de phosphates en excès.

(2) *Réactif de Boettger* (ou du perchlorure de fer).

Ce réactif décèle la présence de l'acide sulfocyanique.

Par ses variations, il permet d'apprécier la présence en grande quantité d'oxalates et de phosphates acides de soude et les phosphates ammoniaco-magnésiens.

(3) *Le réactif de Gondouin,* permet d'évaleur le chlore du chlorure de sodium ($NaCl$).

L'acide tartrique permet de reconnaitre le chlore du chlorure de potassium KCl. Ce chlorure est peu important à rechercher; nous ne faisons sa recherche que rarement.

(4) *Par le réactif de Gram Von Jaksch* (réactif iodo-ioduré) on décèle le glycogène, l'érythrodextrine($C^{12}H^{10}O^{10}$). Le glucose ($C^6H^{12}O^6$). Le glucose, nous l'avons vu, est déjà décèlé par le réactif de Nessler.

(5) *Par le réactif de Gorup-Besanez* on peut rechercher la présence du phosphate acide de soude (H^2NaPO^4). Ils

sont déjà déterminés indirectement, ainsi que les phosphates ammoniaco-magnésiens, par la réaction du perchlorure. $Mg(AzH^4)PO^4$.

Ainsi, avec quatre réactions simples à faire, nous déterminerons les variations de quantité de neuf corps chimiques: AzH^3—AzH^4Cl; $CAzSH$; $NaCl$; KCl; $C^{12}H^{10}O^{10}$; $C^6H^{12}O^6$; H^2NaPO^4. $Mg(AzH^4)PO^4$.

(B) Réaction au Tournesol.

Nous prenons un papier de tournesol rouge et bleu et nous le trempons dans la salive fraîche.

(1) Il peut ne se produire aucun changement (minima) = neutre.

(2) La partie rouge peut devenir bleue = alcaline. La partie bleue peut devenir rouge, la partie rouge peut devenir bleue = amphotère. La partie bleue peut devenir rouge = acide (maxima).

Normalement la salive est neutre (et non pas légèrement alcaline comme on le dit très souvent).

La salive est alcaline chez les hypoacides.

Elle est neutre ou légèrement acide chez les cholémiques.

Elle est amphotère ou nettement acide chez les uricémiques.

(C) Réactif de Nessler.

Le réactif de Nessler donne avec la salive mixte, des réactions colorées avec ou sans précipité.

Les couleurs que l'on peut obtenir sont: crême, jaune clair, jaune foncé, pelure d'oignon, jaune orangé, mine orangé, chamois clair, ocre jaune, ton de bois, havane clair, mine orangé virant au bleu ardoisé.

La couleur pelure d'oignon est la coloration de la salive normale.

Les couleurs crême, jaune clair, jaune foncé, pelure d'oignon, ne précipitent pas. Les autres couleurs s'accompagnent de la formation d'un précipité.

Les différentes colorations de cette gamme chromatique correspondent à des états chimiques différents de la salive, et par conséquent à des états morbides divers.

1. DES VARIATIONS DANS LA RÉACTION DE NESSLER ET DE LEUR CORRESPONDANCE AVEC DES ÉTATS CHIMIQUES.

Le réactif de Nessler donne:

(1) *En présence du chlore des chlorures:*

(a) KCl. NaCl. Coloration mine orangé. Par dessication incolore, sans cristallisation. Par conséquent, les chlorrures alcalins de soude et de potasse modifient, en les atténuant, les indications du réactif, à la condition qu'ils soient supérieurs à AzH^3 (dyspepsie, precirrhose).

(b) KCl. $NaCl > AzH^4Cl$. Coloration ocre jaune avec précipitation d'urobilinate d'ammoniaque ou d'un composé mercurique à petites granulations rouges.

(2) *En présence de:*

(a) Phosphate neutre de soude HNa^2PO^4. Coloration chamois clair à ocre jaune, diffusible, irrégulière (précipité) = goutte, période prégoutteuse.

(b) Phosphate acide de soude H^2NaPO^4. Forte coloration jaune ocre (précipité) = (goutte).

(c) Phosphates ammoniaco-magnésiens $Mg(AzH^4)PO^4+6H^2O$ précipité; coloration variant de jaune ocre à havane clair (cirrhotiques et rhumatisants, artério-sclérose dernière période).

(3) *En présence des composés acides* (leucomaines), acide oxalique. Trace

de coloration seulement, à moins d'être combiné avec AzH^3 (coloration jaune clair) = type rhumatisant.

(4) *En présence de glucose.* Forte coloration mine orangé qui se transforme rapidement en coloration bleu grisâtre.

(5) *En présence d'urobiline.* Précipité filamenteux ou amorphe d'une coloration rosée qui se perd après dessiccation. Si on absorbe l'excès du liquide avec un papier buvard, on conserve la coloration par dessiccation.

(D) DES VARIATIONS DE COLORATION DANS LA RÉACTION DE NESSLER ET DE LEUR CORRESPONDANCE AVEC DES ÉTATS MORBIDES.

Caractéres généraux de la réaction.	Coloration obtenue.	Propriétés concomitantes.	États de santé correspondants.
A—Réactions régulières, miscibles, immédiates, mineures.	Crême.	Salive neutre. Salive acide.	État normal. Diabète.
	Coloration jaune clair, jaune foncé, jaune orangé.	Salive alcaline.	Hypoacides (état réel). La réaction des sulfocyanures est deux fois plus faible que celle de l'ammoniaque.
		Salive neutre. Salive acide.	Hypoacides (état virtuel). La réaction des sulfocyanures est une fois plus faible que celle de l'ammoniaque. Salive normale. La réaction des sulfocyanures est égale à celle de l'ammoniaque oxalémiques.
B—Réaction régulière normale.	Pelure d'oignon.	Neutre.	État normal (adultes). La réaction des sulfocyanures est égale à celle de l'ammoniaque.
C—Réaction irrégulières, précipitées immédiates, majeures.	Mine orangé.	Salive neutre, odoreuse secondairement ($AzH^3 > CAzSH$).	Cholémiques (psychopathies, phobies, vésanies, migraines, dyspepsies, gastricisme, coprostase.
	Chamois clair.	Salive faiblement, acide inodore.	État migraineux, vertigo, dyspepsie prégoutteuse (uricémie, état virtuel).
	Ocre jaune.	Salive acide ou amphotère—inodore.	Diathèse uricémique vraie. État réel. Goutte confirmée. Rhumatisme goutteux. Hyperchlorhydrie. Maladies se rattachant à la goutte.
	Ton de bois à havane clair.	Salive acide et inodore.	Diathèse oxalémique. Neuroarthritiques. Rhumatisants. Asthénie musculaire, neurasthénie.
D—Réactions avec colorations successives.	Coloration mine orangé virant au bleu grisâtre.	Salive acide.	Diabète.
E—Réaction négative.	Coloration nulle.		Cancéreux

(D) RÉACTION DE BOETTGER.

Comme le réactif de Nessler, le réactif de Boettger (perchlorure de fer à 10 per cent.) donne avec la salive mixte, des réactions colorées avec ou sans précipité. Les couleurs obtenues sont: jaune paille, blanc ivoire, jaune sable, rose saumon, pelure d'oignon, rose pâle, rose clair, rose doré, andrinople moyen, rouge de Venise.

Toutes ces réactions sont régulières, miscibles, immédiates, sans précipité sauf celles qui se traduisent par une coloration rouge de Venise (précipitation immédiate).

Normalement, on obtient la coloration pelure d'oignon.

Les réactions régulières moins foncées que cette couleur, sont dites régulières mineures (jaune paille, blanc ivoire, jaune sable, rose saumon).

Les colorations régulières plus foncées sont dites régulières majeures (rose clair, rose doré, andrinople moyen).

Les différentes colorations de cette gamme chromatique correspondent, comme celles du réactif de Nessler, à des états chimiques et à des états cliniques différents.

I. DES VARIATIONS DANS LA RÉACTION DE BOETTGER ET DE LEURS CORRESPONDANCE AVEC DES ÉTATS CHIMIQUES.

La réaction des sulfocyanures varie beaucoup suivant qu'on envisage la salive d'un enfant, d'un adulte ou d'un vieillard.

Dans le jeune âge, et chez les hypoacides, on obtient généralement une teinte rose saumon. Dans ces deux cas en effet la salive est très aqueuse et contient peu de sulfocyanures.

Chez l'adulte diathésique, on obtient des colorations variant du rose doré au rouge de Venise.

Chez le vieillard, on a une réaction négative ou des teintes très pâles (jaune paille, blanc ivoire, jaune sable). Ceci tient à ce que, dans ces cas, la réaction des sulfocyanures est cachée par la présence de phosphate acide de soude ou d'oxalates. En effet:

(1) En présence du chlore des chlorures, on obtient une faible coloration rose saumon fugace.

(2) En présence de H^2NaPO^4 on obtient une très faible coloration ou pas de coloration (caractéristique des hépatiques uricémiques goutteux). Chez les hyperacides goutteux, l'acide urique, devant le phosphate neutre, devient urate de soude: le phosphate neutre devient phosphate acide, corps qui donne à la salive sa réaction acide et qui masque la réaction du sulfocyanure.

(3) En présence d'oxalates, la réaction des sulfocyanures est négative: en effet, acide sulfocyanique et acide oxalique sont deux uréides acides; la présence de l'un des deux principes exclut l'autre principe de la constitution de la salive.

II. DES VARIATIONS DANS LA RÉACTION DE BOETTGER ET DE LEUR CORRESPONDANCE AVEC DES ÉTATS MORBIDES.

(a) *Réactions immédiates miscibles.*

Normalement, la réaction des sulfocyanures donne une coloration pelure d'oignon.

(A) *Les colorations mineures* (jaune paille, blanc ivoire, jaune sable, rose saumon) peuvent correspondre à l'état normal, à la diathèse cholémique ou à la diathèse uricémique.

(1) Lorsqu'elles correspondent à la normale, la salive a ses caractères organoleptiques normaux (opalescence, pas d'odeur secondaire . . . .). Elle est neutre au tournesol. La salive alors est peu riche en sulfocyanures. La coloration au réactif de Nessler est identique à celle que donne le Boettger.

(2) Lorsqu'elles correspondent à la diathèse des hépatiques cholémiques (psychopathics) la réaction de l'ammoniaque est supérieure à celle des sulfocyanures.

La salive amère, est neutre au tournesol.

(3) Lorsqu'elles correspondent à la dyscrasie des hépatiques uricémiques goutteux, la réaction ammoniacale est irrégulière (précipité) la salive est inodore, acide au tournesol; le sulfocyanure est masqué par la présence de phosphate acide de soude.

(4) Lorsqu'elles correspondent à la dyscrasie des hépatique oxaluriques, la réaction à l'ammoniaque donne une coloration jaune clair.*

On trouve en préparation histologique de l'oxalate d'ammoniaque (nevropathiques, rhumatisants).

(B) *Les colorations majeures correspondent:*

Le rose pâle	Hépatisme cholémique, dyspepsie.
Le rose clair	Hépatisme goutteux: goutte et surtout maladies du même groupe que la goutte.
Le rose doré	
L'andrinople moyen	Hépatisme oxalémique rhumatisme, diabète.

(b) *Réactions immédiates et précipitées.*

La réaction au sulfocyanure est précipitée rouge Venise supérieure à la réaction de l'ammoniaque qui est elle-même>1 et précipitée. Il y a excès de phosphates ammoniaco-magnésiens (neurasthénie. État grave de la déminéralisation de l'organisme).

RÉACTION DE L'AMMONIAQUE PAR LE RÉACTIF DE NESSLER.

Caractères généraux de la réaction au Nessler.	Réaction au tournesol.	Coloration par le Nessler.	Rapport docimasique du Nessler et du Boettger (sulfocyanures).	Caractéristiques de la réaction de Boettger	Réaction des chlorures.	États de santé correspondants.
I. Réactions régulières, miscibles, immédiates, mineures.	Alcaline.	Jaune clair, jaune foncé, jaune orangé.	>2	Nulle ou régulière mineure (jaune paille).	<1	Diathèse hypoacide (état réel).
	Neutre.	Jaune clair, jaune foncé, jaune orangé.	>1	Nulle ou régulière mineure (jaune paille, blanc ivoire, jaune sable, jaune saumon).	<1	Diathèse hypoacide (état virtuel).
		Crême, jaune clair, jaune foncé, jaune orangé.	$=$	Nulle ou régulière mineure (jaune paille, blanc ivoire, jaune sable, jaune saumon).	$=1$	Normale chez les enfants.

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* Il y a réaction nulle dans la diathèse hypoacide, chez quelques goutteux, chez les oxaluriques à l'acide oxalique abondant et chez quelques cancereux.

II. Réaction régulière normale.	Acide.	Crème. Jaune clair.	<	Régulière majeure (andrinople moyen).	>1	Diabète.
				Réaction nulle ou régulière mineure (jaune paille, blanc ivoire).		Neuropathiques rhumatisant (présence d'oxalates en excès).
	Neutre.	Pelure d'oignon.	=	Pelure d'oignon.	=1	Normale (adultes).
III. Réactions irrégulières, précipitées, immediates majeures.	Alcaline.	Jaune ocre à havane clair.	<	Irrégulière majeure (rouge de Venise).	<1	État grave de déminéralisation de l'organisme; dernière période des maladies (neurasthénie; cirrhose; angine de poitrine); présence des phosphates ammoniaco-magnésiens).
	Neutre.	Mine orangé.	>	Régulière mineure (jaune paille, blanc ivoire, jaune sable),	=ou<1	Cholémie, psychopathies, vésanies, phobies.
				Régulière majeure (rose pâle).	=ou<1	Cholémie, dyspepsie, gastricisme, précirrhose, coprostase.
	Légèrement acide.	De mine orangé à chamois clair (présence de phosphates neutres de soude).	>	Régulière majeure (rose clair).	=1	Anémie.
					>1	Migraines, vertiges. Dyspepsie prégoutteuse. Hyperchlorhydrie. Uricémie (état virtuel).
			=	Régulière majeure (rose doré).	>1	Hépatisme goutteux. Goutte et surtout maladies se rapportant à la goutte (asthme, eczéma).
	Amphotère ou acide.	Jaune ocre.	>	Régulière mineure (jaune paille, blanc ivoire, jaune sable).	>1	Diathèse uricémique confirmée. État réel—goutte, rhumatisme goutteux. Hyperchlorhydrie (présence de phosphate acide de soude).
	Acide.	Ton de bois.	<	Régulière majeure (andrinople moyen).	=1 ou<1	Hépatisme oxalémique. Neuroarthritisme, arthropathies, rhumatisme musculaire. neurasthénie.
IV. Réaction à colorations successives.	Acide.	Mine orangé virant au bleu grisâtre.		Régulière majeure (andrinople moyen).	>1	Diabète.
V. Réaction négative.		Nulle.		Nulle.	O	Cancer—état grave.

(E) RÉACTION DE GONDOUIN. (Recherche du chlore des chlorures.)

Aux deux gouttes de salive mises sur la palette de porcelaine, on ajoute une goutte de chromate jaune de potasse. Le mélange se fait et la salive prend une coloration jaune. On fait tomber alors de 4 à 5 cm. de hauteur une goutte de nitrate d'argent au pair.

S'il se produit une coloration rouge persistante, le chlorure est inférieur à la normale.

Si la réaction rouge disparait, virant lentement au jaune, le chlore est égal à la normale $= 1$.

Si après l'adjonction du nitrate d'argent, il ne se produit pas de coloration, le chlore est supérieur à la normale.

Lorsque le chlore est <1, il y hypochlorhydrie. Le sel composant est dans ce cas le chlorhydrate d'ammoniaque lorsque la réaction de Nessler est >1.

Lorsque le chlore est >1 et que le précipité ammoniacal est faible, cela indique que le chlore est dû aux chlorures de sodium et de potassium. Cette réaction est caractéristique de la diathèse uricémique goutteuse. Il y a hyperchlorhydrie (voir page 60).

Lorsque le chlore est égal à la normale, ou bien la salive est normale, ou bien il s'agit de la salive d'un cholémique.

(F) RÉACTIF DE GRAM VON JAKSCH. (Iodo-ioduré.)

Le réactif de Gram Von Jaksch permet de décéler le glycogène, l'erythrodextrine, et le glucose.

Il donne avec ces différents corps une coloration rouge acajou. S'il reste après dessiccation, une faible coloration violacée au bord periphérique de la préparation, il s'agit de glycogène.

S'il reste une forte coloration rouge brun, il s'agit d'érythro-dextrine.

Le glucose donne la même réaction que l'erythro-dextrine.

L'achroo-dextrine ne se caractérise pas.

On trouve souvent des dextrines chez lez cancéreux et chez les hyperacides.

(G) RÉSULTATS ACQUIS.

Telles sont les seules réactions chimiques que nous fassions. Nous allons essayer de résumer en un tableau les types salivaires morbides qu'elles permettent de différentier.

Puis, nous comparerons les résultats obtenus avec les résultats que donnerait une analyse quantitative des divers éléments de la salive et ceux que donne l'analyse complète des urines.

Nous pourrons ainsi, croyons-nous, faire ressortir clairement la simplicité et la précision de notre méthode.

Comme base de notre tableau, nous avons pris la réaction de Nessler.

(Voir le tableau, pages 340, 341.)

Ainsi, par la détermination exacte de réactions simples, nous pouvons diagnostiquer des états morbides très voisins.

Mais, pourrait-on nous dire, par l'analyse docémasique chimique, peut-être arriverait-on à plus de précision?

Sans doute, par cette analyse, dans les états dyscrasiques, on pourra observer des variations quantitatives et qualitatives des différents corps pouvant entrer dans la composition de la salive. Mais ces différences, souvent extrêmement minimes, seront toujours plus difficiles à interpréter que nos variations de coloration, et les conclusions tirées ne seront pas plus précises.

Nous n'en voulons pour exemple que l'observation suivante dans laquelle l'analyse de la salive a été faite par notre méthode et par la méthode docémasique chimique. De plus, une analyse complète d'urine, faite en manière de contrôle, nous permet d'y voir que les données de la sialologie sont aussi précises que celles de l'urologie en ce qui concerne les maladies dyscrasiques.

I. SIALO-SÉMÉIOLOGIE ANALYTIQUE.

M. Paul D., age de 45 ans.

Caractères organoleptiques.

Quantité	normale
Coloration	blanche
Aspect	muqueuse
Transparence	normale
Consistance	fluide
Odeur	bilieuse
Sapidité	?

Analyse du 29 mai 1901, par Michaels.

Réactions chimiques.

$CAzSH$	○ Laqué	1
AzH^3		1
AzH^4Cl	⊙ >	1
$NaCl$	>	1
KCl		1
$C^{12}H^{10}O^{10}$	=	1
$C^6H^{12}O^6$		0
HNa^2PO^4		0
$Mg(AzH^4)PO^4$		0

Cristallisation microchimique.

Hépatotoxines	0
Sels acides	0
Sels alcalins terreux	0

Leucomaines—oxalate d'ammoniaque, pigmentation, dépôt brunâtre, bilieux.

Tournesol.

Neutre	0
Alcalin	0
Acide	faible.
Amphotère	0

Résumé sialoscopique. $CAzSH$ AzH^3 précipité Cl 1; réaction acide.

Diathèse indiquée. Hyperacidité oxalique.

Neurasthénie dépressive; impuissance; abrasion chimique des dents; pas de carie dentaire.

II. SALIVE DE M. PAUL D.

Bull. d'analyse N° 28.425 Série II, par M. Gautrelet.

(A) *Généralités.*

Aspect = muqueux. Couleur = blanche. Consistance = fluide. Odeur = fétide. Réaction = acide faible. Densité = 1003-5.

(B) *Docemasie chimique.*

Sels normaux inorganiques.

Eléments dosés.	Salive examinée.	Normale
Acidité de PO^5	0,600	Alcalin.
Chlorures salins	0,200	1,200
Phosphates alcalino-terreux	0.048	
Sulfates	0.045	

Corps organiques.

Urée	0,870	0,800
Sulfocyanure AzH^5	0,002	0,060
Leucomaines	traces nettes	....
Mucine	1,240	1,620
Albumine	1,270	3,000
Ptyaline	2.300	1,840
Residu total	9,450	11,840
Eau	993,050	992,160

(C) *Examen histologique.* Éléments constantes: Cellules épithéliales.

(D) *Examen bacteriologique.* Éléments constantés: Cocci. Streptococcus pyogenes aureus. Bacterium termo. Leptothrix buccalis.

Paris, le 10 décembre 1901.

III. BULLETIN D'ANALYSE DES URINES DE M. PAUL D.

Bulletin d'analyse N° 28.388.

(A) *Propriétés organoleptiques.* (1) Couleur, jaune rouge. (2) Aspect, limpide. (3) Transparence, complète. (4) Consistance, fluide. (5) Surface, nette. (6) Dépôt, faible, floconneux. (7) Sédiment, rare amorphe. (8) Agitation, mousse peu persistante. (9) Fluorescence, normal. (10) Odeur, faible.

(B) *Généralités.* (Essai.)

Réaction chimique.

Urine examinée.	Urine normale.
Acide libre	acide par sels acides.

Densité.

1006,1 1017,8

Mais la plupart gagnent encore en sensibilité et en sureté si l'on a soin de contrôler leurs résultats par un examen microscopique.

Avec l'emploi du microscope, beaucoup de substances organiques (acides organiques, alcaloides) ou inorganiques, peuvent se déterminer, en l'absence de tout réactif, par leurs formes cristallines propres. (Art. Léon Bourgeois: Microchimie. Dict. Chimie. Wurtz.)

(C) *Résumé comparitif.*

Augmentation des éléments normaux	Absolue: acidité, mucine. Relative: phosphates, urobiline. chlorures, urates, skatol, leucomaines.
Diminution des éléments normaux	Absolue: d'ensemble. Relative: phosphates.
Éléments anormaux.	Oxalate de chaux régulière peptones.
Examen histologique: vibrio lactis.	

(D) *Les conclusions séméiologiques sont:* (1) Arthritisme diathésique; forme goutte. (2) Congestion hépatique (lobe gauche et splénique) avec hypertension. (3) Dyspepsie catarrhale, hyperchlorhydrie et oxalique. (4) Neurasthénie par autointoxication (coprostase).

Ainsi, les données des deux examens concordent. Nous avions du reste déjà insisté sur ce point dans notre dernier travail. (Voir pages 76-78.)

Nous avons cru bon d'y revenir en publiant cette observation inédite.

(D) ÉTUDE DES CARACTÈRES MICROCHIMIQUES.

La plupart des réactions qu'utilise l'analyse chimique proprement dite sont donées d'une exquise sensibilité. Tout chimiste soigneux arrive à entirer bon parti avec un peu de pratique, même lorsqu'il n'opère que sur quelques gouttes de liquide.

Or, les dyscrasies diathésiques sont déterminées par l'accumulation dans l'organisme, de principes chimiques cristallisables tels que les sels acides ou basiques, les leucomaines, les uréides, les toxines hépatiques.

Ces espèces de corps ne sont jamais retirées de l'économie qu'en très petites quantités: à plus forte raison, existent-elles seulement à l'état de traces infinitésimales dans deux gouttes de salive: les cristaux sont très petits, il faut pour les voir, interposer entre eux et l'œil un instrument grossissant, un microscope. Sous ce rapport là, l'emploi de pouvoirs amplifiants considérables est habituellement aussi indispensable dans ce genre d'étude que dans toute autre, quoique cependant, le plus souvent, il ne soit pas nécessaire d'aller aussi loin à cet égard qu'en histologie.

Dès lors, les cristaux sont visibles et leurs réactions microchimiques extrêmement sensibles et caractéristiques.

Pour plus de précision, certains auteurs disposent même le microscope de manière à pouvoir étudier les actions chimiques de divers réactifs sur les principes cristallisés: nous croyons, pour notre part, que, au point de vue pratique, la reconnaissance des cristaux formés sans réaction chimique donne des résultats suffisants.

Si l'emploi du microscope permet d'étudier la forme des cristaux presque aussi facilement qu'on peut le faire à l'œil nu sur les espèces d'origine minérale, s'il permet d'étudier la couleur de ces cristaux, il ne permet pas de tirer parti des différences de consistance, d'élasticite, de densité, pour distinguer l'une et l'autre des espèces. En ajoutant au microscope un appareil polariseur, on peut examiner les modifications que les cristaux font éprouver à la lumière (analyse polariscopique). Ces modifications permettent de caractériser un grand nombre de corps.

L'appareil polariseur que nous employons est l'appareil de Nachet. Il se compose d'un prisme de Nicol (polarisateur), qui, enchassé dans une monture, est substitué aux diaphragmes à mouvement vertical du centre de la platine, et d'un appareil analyseur.

Cet appareil analyseur est formé d'un prisme refringent de spath calcaire; il est fixé dans une monture spéciale au-dessus du centre d'une sorte de capuchon qui peut être superposé à l'oculaire et qui emboite la partie supérieure du microscope. Cette monture est percée en son centre, d'un trou qui correspond à la fois au verre oculaire supérieur et à la face inférieure du prisme. Elle est mobile par rapport au microscope.

Au-dessus du prisme analyseur est une petite plaque métallique qui peut être disposée de telle façon que lorsque les prismes polarisateurs et analyseurs sont croisés, le champ du microscope est devenu obscur.

Introduisons à ce moment notre préparation de salive: si des substances qui polarisent la lumière entrent dans sa composition chimique, ces substances éclairent le champ dans la partie qu'elles occupent: les autres substances, telles que les cristaux de chlorure de sodium . . . . restent sans action, c'est-à-dire, laissent obscur le champ. Ces derniers corps sont dits inactifs ou isotropes, ceux qui agissent sont inversement appelés anisotropes.

Ces cristaux peuvent borner là leur action, c'est-à-dire ne faire que rendre clair le champ obscur du mircoscope.

Mais il en est d'autres, aussi bien que divers corps cristallisés, qui peuvent décomposer cette lumière et donner des images colorées (polarisation chromatique).

Ces différentes notions générales nous permettent de comprendre que la même préparation vue au microseope seul ou au micropolariscope n'aura pas du tout le même aspect: dans le premier cas, les corps isotropes seront surtout en évidence; dans le deuxième cas, on ne verra que les corps anisotropes. Avec une même préparation, on a donc deux séries d'examen différentes.

Tels sont les principes physiques sur lesquels est fondée notre méthode d'analyse microchimique de la salive.

Voici comment nous procédons:

Certains corps étant volatils ou décomposables par l'action de la chaleur, nous faisons avec la salive fraiche 3 séries de préparations sur 3 lamelles différentes; sur chacune des 3 lamelles, nous mettons 2 gouttes distinctes de la salive à examiner: l'une de ces gouttes est couverte; l'autre est découverte.

La première lamelle est mise sous

cloche afin que l'évaporation se fasse lentement. (Préparation athermique à 15°.)

La deuxième lamelle est séchée rapidement sous cloche à air chaud. (Préparation thermique à 50°.)

La troisième lamelle est séchée au-dessus de la flamme d'une lampe à alcool. (Préparation pyrogénique.)

On comprend que les corps décélés dans les trois préparations varieront: dans la 3ème, il ne restera que les corps absolument stables; dans la 1ère seule, les principes alcaloidiques seuls pourront être décélés.

Chaque préparation est examinée: (1) Par le microscope. (2) Par le micro-polariscope.

Mentalement, on divise la préparation en quatre sections = la périphérie, certains éléments se caractérisant plus spécialement à ce niveau.

Par cet examen méthodique fait au microscope et au polariscope, on arrive à décéler tous les corps isotropiques et anisotropiques contenus dans la préparation.

De plus, chaque préparation n'est pas examinée de cette façon qu'une seule fois, mais bien, tous les jours d'abord, pendant une semaine, puis une seule fois par semaine pendant un mois.

En effet, des variations peuvent se pro-

(a) LISTE DES ÉLÉMENTS CRISTALLISÉS QUE NOUS AVONS PU RECONNAITRE DANS LA SALIVE MIXTE PAR PRÉPARATION ATHERMIQUE.

Ces corps comprennent surtout des leucomaines et des hépato-toxines.

Familles chimiques.	Noms des corps chimiques.	Décélés par.	Trouvés dans.
Graisses.	Lécithine et autres corps gras.	Polariscope.	
	Cholesterine.	Microscope.	Cholémie uricémique.
Matières colorantes biliaires.	Urobilinate d'ammoniaque.	Polariscope.	Goutte (état réel). Diabète. Oxalémiques.
Hydrates de carbone.	Glycosane.	Polariscope.	
	Glycosodium.	Microscope.	Diabétiques.
	Tables d'inosite.	Polariscope.	
	Dextrines.		Hypéracides.
Composés amidés; acides amidés; uréides.	Leucine.	Polariscope.	Goutte (état réel).
	Tyrosine.	Polariscope.	Cholémiques. Uricémiques. Goutte (état réel).
	Créatine.	Polariscope.	Goutte.
	Xanthine.	Polariscope.	Cholémiques.
	Urates de soude.	Polariscope.	Goutteux.
	Urée et sulfo-urée.	Polariscope.	Cholémiques.
	Taurine.	Polariscope.	Cholémiques. Goutte (état réel).
	Uréides, leucomaines.	Microscope.	Cholémiques. Uricémiques.
	Sulfocyanures.		Période prégoutteuse. Oxalémiques.
	Oxalurates.		Oxalémiques neuro-arthrisme.
Composés azotés indifférents.	Indican bleu.	Microscope.	Cholémiques (dyspepsies).
Acides organiques non azotés.	Lactates de chaux.	Polariscope.	(Voir tableau suivant).
	Oxalates d'ammoniaque.	Polariscope.	Rhumatisants—surmenés, neurasthéniques, déprimés, quelques anémiques, carcinomateux.

(b) LISTE DES ÉLÉMENTS CRISTALLISÉS QUE NOUS AVONS PU RECONNAITRE DANS LA SALIVE MIXTE PAR PRÉPARATION THERMIQUE.

On reconnait surtout ici les pigments biliaires; les sels acides et alcalis.

Familles chimiques.	Noms des corps chimiques.	Déterminés par.	Trouvés dans.
Matières colorantes biliaires.	Biliverdine.		Goutte eczéma.
	Biliprasine.		Dyspepsiques. Psychopatiques.
	Bilifusine et autres pigments normaux.		
Composés amidés; acides amidés; uréides.	Urée et uréides.	Polariscope.	Diathèse prégoutteuse. Cholémiques.
	Hippurates de soude et de chaux.	Polariscope.	Goutteux.
Acides organiques non azotés.	Lactate de chaux.	Polariscope.	Goutteux et quelques diabétiques eczémateux.
	Oxalates de chaux et d'ammoniaque.	Polariscope.	(Voir tableau précédent).

Composés inorganiques.

Acides.	HCl	Chlorure de sodium.	Microscope.	Hyperchlorhydrie, goutte. (Dans l'hypochlorhydrie, NaCl ne-cristallisé pas).
		Chlorure de potassium.		
		Chlorhydrate d'ammoniaque.	Microscope.	Cholémiques. Phosphoturiques (ammoniaco-magnésiens).
	PhO	Phosphate acide de soude.	Polariscope.	Goutte (état réel).
		Phosphates ammoniaco-magnésiens.	Polariscope.	Rhumatisants et neurasthéniques. (Période de déminéralisation, état grave).
	H^2SO^4	Sulfate de soude (traces).		
	CO^2	Carbonates de soude et de chaux.	Microscope.	Goutte. Goutte.
		Carbonates d'ammoniaque.	Polariscope.	Hyperchlorhydrie, dyspepsies goutteuses pré-cirrhose, diabète.

(c) LISTE DES ÉLÉMENTS CRISTALLISÉS QUE NOUS AVONS PU RECONNAITRE DANS LA SALIVE MIXTE PAR PRÉPARATION PYROGENIQUE.

Ces préparations ne contiennent plus guère que les éléments alcalino-terreux.

Nous les avons trouvés dans la préparation thermique et avons indiqué leur signification thermique.

NOTE.—Nous avons dit que jamais nous ne faisons de réaction colorée dans nos examens microchimiques. Toutefois, lorsqu'il y a intérêt pour le diagnostic, nous décélons les alcaloides par le réactif de Lepage.

duire dans la constitution des corps décélés.

Nous conseillons d'autre part, de faire une nouvelle série de trois préparations athermiques, thermiques pyrogénique, avec la salive, lorsqu'elle sera restée 3 ou 4 jours en flacon fermé. Telle salive qui ne donne pas un acidi-polarispectre sur la préparation faite le premier jour de la réception du flacon, peut donner un résultat positif avec une préparation faite 3 ou 4 jours plus tard.

Ainsi, les phosphates ammoniaco-magnésiens ne se décèlent au polariscope qu'au bout de quelques jours.

Par cette méthode, avec un très petit nombre de préparations simples, ne nécessitant aucun réactif, on en arrive cependants à des données très précises.

Nous résumons dans les trois tableaux (Voir les tableaux, pages 346 et 347) la liste des corps décélés, soit au microscope, soit au polariscope, dans les préparations athermique, thermique, pyrogénique.

Nous indiquons, autant que possible, dans les mêmes tableaux, les états de santé auxquels correspond la prédominance de tel ou tel de ces principes chimiques.

(Voir les tableaux, pages 346 et 347.)

De plus, il y a un grand nombre d'éléments (alcaloides) tant acides que basiques, d'origine pathologique, que nous trouvons dans le rhumatisme, le cancer, le diabète, l'albuminerie et dont nous ignorons actuellement l'importance. Ces éléments sont bien caractérisés par leurs silhouettes spéctrales (anisotropes).

CHAPITRE III.

Des types salivaires dans les différentes dyscrasies diathésiques.

Les notions qui précèdent nous permettront d'établir facilement les types salivaires dans les différentes dyscrasies diathésiques.

Dans notre dernier travail, nous avons publié un bulletin d'analyse sialo-seméiologique comportant un tracé schématique des états diathésiques et de la carie dentaire. (Voir page 80.)

Nous croyons plus simple, dans notre présent mémoire, d'adopter un autre tableau d'analyse.

Notre but n'est pas le même en effet.

Dans notre Communication de 1900, nous avions en vue surtout l'influence des altérations salivaires sur la carie dentaire: l'étude des types diathésiques était au second plan. Voici comment nous prenions les observations sur lesquelles était fondée notre Communication.

Lorsqu'un malade venait nous consulter, nous observions l'état de ses dents; nous observions l'état de sa santé, puis nous lui demandions de prendre un peu de sa salive pour l'analyser, et nous notions alors les caractères de cette salive.

Aujourd'hui, notre façon de procéder este toute autre.

Ayant observé empiriquement un grand nombre de malades (état des dents et diathèse) et analysé leur salive, nous connaissons le type salivaire des principales dyscrasies. Le plus souvent, nous ne voyons même pas le malade. Un médecin nous envoie la salive à analyser sans aucun renseignement. Nous l'analysons et nous tirons de l'analyse notre diagnostic diathésique.

Si le malade a de mauvaises dents, nous en concluons l'évolution probable de la carie.

Le tracé schématique que nous avions adopté dans notre dernier travail serait donc déplacé ici. Nous croyons que le tableau suivant résume mieux les caractéristiques que nous voulons mettre en évidence:

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité ....
Coloration ....
Aspect ....
Transparence ....
Consistance ....
Odeur ....
Sapidité ....

Réactions chimiques.

CAzSH	1
AzH^3	1
AzH^4Cl	1
NaCl	1
KCl	1
$C^{12}H^{10}O^{10}$	1
$C^6H^{12}O^6$	1
HNa^2PO^4	1
$Mg(AzH^4)PO^4$	1

Tournesol.

Neutre ....
Alcalin ....
Acide ....
Amphotère ....

Cristallisations microchimiques.

Hépatotoxines ....
Sels acides ....
Sels alcalins terreux..................
Leucomaines ....

Résumé Sialoscopique ....
Diathèse indiquée ....
Diagnostic ....

En suivant ce tableau, nous allons tâcher de résumer les caractères de la salive normale et des salives pathologiques.

- Hypoacides.
- Hyperacides = hépatiques.
  - Cholémiques.
  - Uricémiques.
    - Uricémique vrai.
    - Diabétique.
    - Oxalémique.
  - Mixte.

en déterminant autant que possible les variations du schéma général d'un groupe dans les diverses maladies qui composent ce groupe.

Pour chaque groupe aussi, nous résumerons les lésions dentaires caractéristiques.

(Voir les tableaux, pages 350 et 351.)

Ce TABLEAU (page 351) nous permet de dresser les trois cartes suivantes:

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	considérable.
Coloration	nulle.
Aspect	limpide.
Transparence	complète.
Consistance	fluide.
Odeur	secondaire: nauséabonde.
Sapidité	?

Tournesol.

Neutre	=	1.
Alcalin	0	1.
Acide	0	1.
Amphotère	0	1.

Réactions chimiques.

CAzSH	0 <	1.
AzH^3	0 <	1.
AzH^4Cl	=	1.
NaCl	= ou <	1.
KCl		1.
$C^{12}H^{10}O^{10}$		1.
$C^6H^{12}O^6$		1.
HNa^2PO^4	>	1.
$Mg(AzH^4)PO^4$		1.

Cristallisation microchimique.

Hépatotoxines	0
Sels acides	< 1
Sels alcalins terreux	0
Leucomaïnes	existent quelquefois.

Résumé Sialoscopique: $AzH^3 > CAzSH$).
Diathèse indiquée: Diathèse hypoacide (état virtuel).
Diagnostic ....

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	abondante.
Coloration	nulle.
Aspect	limpide.
Transparence	complète.
Consistance	fluide.
Odeur	secondaire: nauséabonde.
Sapidité	nulle.

(Suivre, à page 356.)

(A) SALIVE NORMALE.

I. CARACTÈRES ORGANOLEPTIQUES.	II. RÉACTION AU TOURNESOL.	III. RÉACTIONS CHIMIQUES.	IV. CRISTALLISATIONS MICROCHIMIQUES.
Quantité ....normale. Coloration .... incolore. Aspect ....opalescent. Transparence .....semi-transparente. Consistance .....Spumeuse un peu filante (sédiments blancs peu abondants). Odeur ....inodore, pas d'odeur secondaire. Saveur .... insipide.	Neutre.	*(a) Réactif de Nessler.* AzH^3: réactions régulière, miscible, immédiate. La réaction peut être crême, jaune claire, jaune foncé, jaune orangé, pelure d'oignon. Elle est toujours égale à celle de la réaction de sulfocyanures. $AzH^3 = CAzSH$. $AzH^4Cl = 1$. $C^6H^{12}O^{10} = 0$. Phosphate acide de soude ....0. Phosphate neutre de soude ....0. Phosphate ammoniaco = magnésiens ....0. *(b) Réactif de Boettger.* Sulphocyanures. La réaction est régulière immédiate, miscible. La coloration peut être jaune paille, blanc ivoire, jaune sable (enfants), pelure d'oignon (adultes). La teinte est toujours égale à celle obtenue par le Nessler. Chlore des chlorures.....................................1. Phosphate acide de soude.................................0. Oxalates ....0. *(c) Réactif de Gondouin.* Après addition de nitrate d'argent, il se fait une coloration rouge qui vire lentement au jaune = $NaCl = 1$. *(d) Réactif de Gram Von Jaksch.* Réaction de glycogène = coloration rouge acajou. Après dessiccation, faible coloration violacée au bord périférique de la préparation.	Hépatotoxines .. = 0. Sels acides...... = 0. Sels alcaline terreux .... = 0. Leucomaines ... = 0.

(B) DIATHÈSE HYPOACIDE.

I. Caractères organoleptiques.	II. Réaction au tournesol.	III. Réactions chimiques.	IV. Cristallisations microchimiques.
Quantité ....abondante. Coloration .....primitive: incolore. Pas de coloration secondaire. Aspect ....limpide. Transparence ....complète. Consistance ......fluide (par sels de sodium et AzH^4Cl). Odeur ......primitive: nulle; secondaire: nauséabonde.	Neutre ...... = état virtuel. Alcaline .... = état réel.	*(a) Réactif de Nessler.* AzH^3: réaction régulière miscible non précipitée. Coloration jaune claire, jaune foncé, jaune orangé. La coloration est toujours plus intense que celles des sulfocyanures. Si elle est une fois plus intense que celle des sulphocyanures, la diathèse est à l'état virtuel. Si elle est deux fois plus intense que celle des sulphocyanures, la diathèse est à l'état réel. $AzH^4Cl = 1$ (virtuel) > 1 (réel). $C^6H^{12}O^6 = 0$ Phosphate acide de soude ....0. Phosphate neutre de soude.............................> 1. Phosphate ammoniaco-magnésiens ....$=$ ou > 1. (chez phosphaturiques alcalins (asthénie). *(b) Réactif de Boettger.* CAzSH: (a) A l'état virtuel, la réaction est nulle ou est immédiate régulière miscible, toujours < 1. Elle est jaune paille, blanc ivoire, jaune sable, rose saumon. Elle est une fois $<$ réaction de Nessler. (b) A l'état réel, la action est le plus souvent nulle ou bien elle est immédiate, régulière, jaune paille $<$ réaction de Nessler. Chlore des chlorures ....< 1. Phosphate acide de soude ....0. Oxalates ....0. *(c) Réactif de Gondouin.* Après addition de nitrate d'argent, il se produit une coloration rouge persistante. $Cl < 1 =$ hypochlorhydre. *(d) Réactif de Gram Von Jaksch.* Chez les hypoacides, pas de réaction positive.	Pas de cristallisations de sels acides. Urée. Alcaloides.

(C) HYPERACIDES.

1. Hépatique Cholémiques.

I. Propriétés organoleptiques.	II. Réaction au tournesol.	III. Réaction chimiques.	IV. Cristallisation microchimique.
Quantité ....variable: généralement = 1. Coloration ....primitive: grisâtre. secondaire: jaunâtre—cacochymie. vert noirâtre. bleuté—psychopathies. brunâtre (cristallisation). chorée, précirrhose. ictère (cirrhose de Hanot). rouge—psychopathies. Aspect ....limpide (éléments biliaires). Transparence ....complète (éléments biliaires). Consistance ....fluide (par éléments biliaires). Odeur .... primitive: bilieuse. secondaire: nauséabonde. Saveur .. ..amère.	Neutre ou légèrement acide.	*(a) Réactif de Nessler.* AzH^3 réaction irrégulière, précipitée, immédiate, majeure (> 1). Coloration mine orangé, supérieure à la coloration des sulphocyanures. $AzH^4Cl = 1$. $C^6H^{12}O^6 = 0$. Phosphate neutre de soude ....= 1. Phosphate acide de soude ....= 1. Phosphates ammoniaco-magnésiens ....= 0. *(b) Réactif de Boettger.* CAzSH réaction régulière miscible mineure ou = 1 et inférieure à celle de l'ammoniaque ($AzH^4 >$ CAzSH). Coloration jaune paille, blanc ivoire, jaune sable dans les psychopathies, vésanies, phobies; coloration rose pâle surtout dans la dyspepsie, cholémique (précirrhose). Chlore des chlorures ....1. Phosphate acide de soude ....0. Oxalates ....0. *(c) Réactif de Gondouin.* Après addition de nitrate d'argent il se produit une coloration rouge persistante ou passagère. *(d) Réactif de Gram Von Jaksch.* On peut déceler la presence des dextrines.	Preparation athermique—cholesterine, tyrosine, xanthine, urée, et sulfo-urée, taurine, indican bleu (dyspepsie), leucomaïnes. Preparation thermique—pigments biliaires, chlorhydrate d'ammoniaque surtout si phosphaturie concomitante).

(D) HÉPATIQUES URICÉMIQUES.

(*a*) HÉPATIQUES URICÉMIQUES VRAIS.

I. CARACTÈRES ORGANOLEPTIQUES.	II. RÉACTION AU TOURNESOL.	III. RÉACTIONS CHIMIQUES.	IV. CRISTALLISATIONS MICROCHIMIQUES.
Quantité ......variable = 1 (period virtuelle) < 1 (period réele). Coloration ......primitive: grisâtre. secondaire: verdâtre—eczéma, goutte. noirâtre—cancer. Aspect ....opalescent—goutte boueux—catarrhal, asthme, albuminerie. Transparence .....semi-transparence —goutte. opaque—catarrhal. Consistance ....filandreuse. (par albumen en excès), goutte. glaireuse (par fibrine)—catarrhal. visqueuse—albuminerie. Odeur ....primitive, nulle. secondaire, nulle. Saveur ......metallique quelquefois, vireuse dans d'autres cas.	Légèrement acide: migraine, vertige, dyspepsie prégoutteuse. Maladies se rapprochant de la goutte; asthme; eczéma. Amphotère ou acide: diathèse goutteuse confirmé. Hyperchlorhydrie; goutte. Rheumatisme goutteux.	(*a*) *Réactif de Nessler.* AzH³ réaction irrégulière, immédiate, précipitée, majeure (> 1). Variant du chamois claire au jaune ocre fort. La coloration de l'ammoniaque est égale ou plus grande que celle des sulphocyanures. Chlorhydrate d'ammoniaque > 1. Phosphate neutre de soude. (coloration chamois claire) > 1. précipité. = period prégoutteuse. Phosphate acide de soude. (coloration jaune ocre fort) > 1. précipitée. = period prégoutteuse. Phosphate ammoniaco-magnésien = 0. Urobiline > 1. (*b*) *Réactif de Boettger.* CAzSH réaction régulière, immédiate (< 1). Jaune paille, blanc ivoire, jaune sable ou majeure (> 1) (rose claire, rose doré) plus petite ou égale à la réaction de l'ammoniaque. [*Ces différentes variations permettent d'etablir le diagram suivant. Voir Tableau A*, page 356.] Phosphate acide de soude (jaune paille........) > 1 Goutte confirmèe. Oxalates = 0. (*c*) *Réactif de Gondouin.* Le chlore peut être égal à la normale (anémie). Le plus souvent, il est supérieur à la normale (pas de coloration après addition de nitrate d'argent). Goutte confirmée, hyperchlorhydrie. (*d*) *Réactif de Gram Von Jaksch.* Dextrines, erythro-dextrines (forte coloration rouge brun à la préparation).	Préparation athermique: urobilinate d'ammoniaque —goutte (état réel). dextrine. leucine; tyrosine—goutte (état réel). créatine. urates de soude—goutte tophus. taurine — goutte (état réel). sulfocyanures—période prégoutteuse. leucomaïnes. Préparation thermique: hippurate de soude et de chaux—goutte. lactate de chaux—eczema. chlorure de sodium—goutte hyperchlorhydrie. phosphate acide de soude — goutte (état réel). carbonate de soude — goutte. carbonate d'ammoniaque—hyperchlorhydrie. dyspepsie goutteuse. précirrhose.

(D) HÉPATIQUES URICÉMIQUES.

(b) URICÉMIQUES DIABÉTIQUES.

I. CARACTÈRES ORGANOLEPTIQUES.	II. RÉACTION AU TOURNESOL.	III. RÉACTIONS CHIMIQUES.	IV. CRISTALLISATIONS MICROCHIMIQUE.
Quantité ....très faible. Coloration ....primitive: blanchâtre ou grisâtre. secondaire = 0. Aspect ....louche. Consistance ....visqueuse (glucose). Odeur .....primitive: éthérée, quelquefois acétonique. Saveur ....sucre.		*(a) Réactif de Nessler.* 1. AzH^3 réaction régulière mineure (< 1). Coloration crême. 2. AzH^3 + glucose. Coloration irrégulière, mine orangé virant au bleu grisâtre. La coloration de l'ammoniaque est plus grande que celle des sulphocyanures. 3. $AzH^4Cl < 1$ faible trace. Phosphate neutre de soude................= 0. Phosphate acide de soude ....= ou > 1. Phosphate ammoniaco-magnésiens ....0. *(b) Réactif de Boettger.* CAzSH réaction régulière majeur (> 1). Coloration andrinople moyen. Oxalates ....0. *(c) Réactif de Gondouin.* Comme chez les goutteux, le chlorure de sodium est généralemente superieure à la normale. *(d) Réactif de Gram Von Jaksch.* Ce réactif dénote l'existance de glucose et d'erythro-dextrine.	Mêmes caractères que chez les goutteux.

(D) HÉPATIQUES URICÉMIQUES.

(c) URICÉMIQUES OXALURIQUES.

I. CARACTÈRES ORGANOLEPTIQUES.	II. RÉACTION AU TOURNESOL.	III. RÉACTIONS CHIMIQUES.	IV. CRISTALLISATIONS MICROCHIMIQUES.
Quantité ....variable. Coloration ......primitive: incolore. secondaire: jaune doré. Aspect ....limpide. Transparence ....complète. Consistance ....fluide. Odeur ....inodore. Saveur ....insipide.	Acide.	(*a*) *Réactif de Nessler et réactif de Boettger.* (a) recherche de AzH^3 et de CAzSH. Les réactions diffèrent suivant que les oxalates dominent ou non. (1) Les oxalates dominent. la réaction avec le Nessler est régulièrement mineure et donne une coloration jaune claire. la réaction avec le sulfocyanure est nulle ou régulière et mineure (< 1) jaune paille, blanc ivoire. (2) Les oxalates ne cachent pas les réactions de l'ammoniaque et des sulfocyanures. la réaction avec le Nessler est irrégulaire (précipitée) majeure (> 1) et donne une coloration ton de bois. la réaction avec le Boettger est régulière, majeure (> 1) et donne une coloration adrianople moyen. Les autres corps décélés par le Nessler donnent: $AzH^4Cl < 1$. Phosphate neutre de soude ....0. Phosphate acide de soude..................0. Phosphates ammoniaco-magnésiens...$>$ 1 (chez neurasthéniques). Glucose ....$=$ 0. Nous avons vu que les oxalates peuvent cacher entièrement la rèaction des sulfocyanures. (*b*) *Réactif de Gondouin.* Le chlore peut être égal à la normale. Le chlore peut être supérieur à la normale. (*c*) *Réactif de Gram Von Jaksch.* On trouve souvent la réaction de l'érythro-dextrine.	Préparations athermiques: urobiline. sulfocyanures. oxalate d'ammoniaque. (dominante). leucomaines variable. Préparations thermiques: phosphates ammoniaco-magnésiens (neurasthénie; periode de déminéralisation de l'organisme).

Tournesol.

Neutre	0	1.
Alcalin		1.
Acide	0	1.
Amphotère	0	1.

Réactions chimiques.

$CAzSH$	0 < ou 0	1.
AzH^3	0	1.
AzH^4Cl		1.
$NaCl$		1.
KCl		1.
$C^{12}H^{10}O^{10}$		1.
$C^6H^{12}O^6$		1.
HNa^2PO^4	>	1.
$Mg(AzH^4)PO^4$		1.

Cristallisation microchimique.

Hépatotoxines	0	
Sels acides	0	
Sels alcalins terreux	0	
Leucomaïnes	1	

Résumé Sialoscopique: $AzH^3 > {}^2CAzSH$.

Diathèse indiquée: Diathèse hypoacide (état réel).

Diagnostic ....

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	abondante.
Coloration	nulle.
Aspect	limpide.
Transparence	transparente.
Consistance	fluide.
Odeur	nulle; secondaire: nauséabonde.
Sapidité	nulle.

Tournesol.

Neutre	0	1.
Alcalin	<	1.
Acide	0	1.
Amphotère	0	1.

Réactions chimiques.

$CAzSH$	0 ... <	1.
AzH^3		1.
AzH^4Cl	>	1.
$NaCl$		1.
KCl		1.
$C^{12}H^{10}O^{10}$		1.
$C^6H^{12}O^6$		1.
HNa^2PO^4		1.
$Mg(AzH^4)PO^4$	>	1.

Cristallisation microchimique.

Hépatotoxines		
Sels acides		
Sels alcalins terreux	phosphates ammoniaco-magnésiens.	
Leucomaïnes	1	

Résumé Sialoscopique:

Diathèse indiquée: Diathèse hypoacide avec phosphaturie

Diagnostic ....

(C) *État des dents chez les hypoacides:*

Dents . . . . carie rapide.

(Voir le tableau, page 352.)

B—Ce TABLEAU (page 352) nous permet d'ébaucher deux types salivaires; l'un dû à la prédominance d'autointoxication par éléments biliaires et qui correspond aux troubles digestifs (cholopoièse, cholomèse) et aux ictères biliphéiques; l'autre, dû à la prédominance d'autointoxications par hépatotoxines pigmentaires et qui correspond aux troubles psychopathiques (phobies, hystérie, vésanies).

TABLEAU A.

Réactif de Nessler.	Réaction de Boettger.	Réaction de NaCl.	Etats de santé concomittants.
De mine orangé à chamois clair (présence de phosphates neutres de soude).	Régulière majeure (rose clair).	=1	Anémie.
		>1	Migraines. vertiges Dyspepsie prégoutteuse. Hyperchlorhydrie. } Uricémie. (état virtuel).
	Régulière majeure (rose doré).	1	Hépatisme goutteux. goutte et surtout maladies se rapportant à la goutte (asthme. eczéma).
Jaune ocre.	Régulière mineure (jaune paille. blanc ivoire, jaune sable).	1	Diathèse uricémique confirmée. État réel. Goutte, rhumatisme goutteux. Hyperchlorhydrie (présence de phosphate acide de soude).

Nous avons pu, ainsi, dresser un peu schématiquement, à la vérité, les deux cartes suivantes:

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	variable > 1
Coloration	grisâtre.—Colorations secondaires.
Aspect	limpide.
Transparence	complète.
Consistance	fluide.
Odeur	bilieuse; secondaire, nauséabonde.
Sapidité	amère.

Tournesol.

Neutre	=	1.
Alcalin	=	1.
Acide		1.
Amphotère		1.

Réactions chimiques.

CAzSH	jaune paille à jaune sable $<$	1.
AzH^3	⊙	1.
AzH^4Cl		1.
NaCl	0	1.
KCl	0	1.
$C^{12}H^{10}O^{10}$	=	1.
$C^6H^{12}O^6$	0	1.
HNa^2PO^4	0	1.
$Mg(AzH^4)PO^4$		1.

Cristallisation microchimique.

Hépatotoxines	surtout pigments biliaires; tyroleucine; indican bleu: AzH^4Cl.	
Sels acides		
Sels alcalins terreux	0	
Leucomaïnes	=	

Résumé Sialoscopique: AzH^3 CAzSH.
Diathèse indiquée: Diathèse cholémique.
Diagnostic: Dyspepsie cholémique; troubles digestifs; vomissements; constipation; diarrhée.

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	> 1.
Coloration	grisâtre.
Aspect	limpide.
Transparence	semi-complète.
Consistance	fluide.
Odeur	
Sapidité	

Tournesol.

Neutre	1.
Alcalin	1.
Acide	1.
Amphotère	1.

Réactions chimiques.

CAzSH	rose pâle =	1.
AzH^3	⊙	1.
AzH^4Cl		1.
NaCl		1.
KCl		1.
$C^{12}H^{10}O^{10}$		1.
$C^6H^{12}O^6$		1.
HNa^2PO^4		1.
$Mg(AzH^4)PO^4$		1.

Cristallisation microchimique.

Hépatotoxines	pigments biliaires; tyrosine, xanthine, taurin.
Sels acides	
Sels alcalins terreux	
Leucomaïnes	abondantes.

Résumé Sialoscopique: AzH^3 CAzSH.
Diathèse indiquée: cholémique.
Diagnostic: psychopathies (phobies, hystérie, vésanie, aboulie).

(C) *État des dents chez les cholémiques:* Carie imminente.

(Voir le tableau, page 353.)

B—Ce TABLEAU (page 353) nous permet, au moins schématiquement, de dresser la carte. (1) De la goutte confirmée: Goutte articulaire, rhumatisme goutteux, hyperchlorhydrie, tophus. (2) De la période prégoutteuse avec anémie, chlorose, troubles gastriques (migraines, période prégoutteuse).

(3) De quelques maladies paragoutteuses: asthme; eczéma.

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité .... inférieure à la normale.
Coloration .... primitive: grisâtre;
secondaire: verdâtre.
Aspect .... opalescent.
Transparence ...... incomplète.
Consistance .... filandreuse.
Odeur .... nulle.
Sapidité .... métallique.

Tournesol.

Neutre .... 1.
Alcalin .... 1.
Acide .... > .... 1.
Amphotère .... > .... 1.

Réactions chimiques.

CAzSH .... < .... 1.
AzH^3 ....jaune ocre > .... 1.
AzH^4Cl ....précipité > .... 1.
NaCl .... > .... 1.
KCl .... 1.
$C^{12}H^{10}O^{10}$ .... = ... 1.
$C^6H^{12}O^6$ .... 1.
H^2NaPO^4 .... > .... 1.
$Mg(AzH^4)PO^4$ .... < .... 1.

Cristallisation microchimique.

Hépatotoxines ....urobiline, urate de soude, taurine, créatine, hippurate de chaux.
Sels acides.............H^2NaPO^4.
Sels alcalins terreux....NaCl = Carbonate de soude.
Leucomaïnes ....

Résumé Sialoscopique ....
Diathèse indiquée: diathèse uricémique (état réel).
Diagnostic: goutte (arthrite), gravelle.

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité .... inférieure à la normale < 1
Coloration .... primitive: grisâtre;
secondaire: verdâtre.
Aspect .... opalescent.
Transparence .... incomplète.
Consistance .... filandreuse.
Odeur .... nulle.
Sapidité .... métallique.

Tournesol.

Neutre .... 1.
Alcalin .... 1.
Acide .... 1.
Amphotère .... 1.

Réactions chimiques.

CAzSH ....rose clair >.......... 1.
AzH^3 ......précipité....chamois........ 1.
AzH^4Cl ....> .... 1.
NaCl ....> ou = ... 1.
KCl .... 1.
$C^{12}H^{10}O^{10}$ .... 1.
$C^6H^{12}O^6$ .... 1.
H^2NaPO^4. ....>.......... 1.
$(MgO)^2AzH^4OPhO^5$ ....>.......... 1.

Cristallisation microchimique.

Hépatotoxines ....créatine.
Sels acides ....
Sels alcalins terreux.....................
Leucomaïnes ....

Résumé Sialoscopique ....
Diathèse indiquée: uricémique (état virtuel).
Diagnostic: anémie avec phosphaturie.

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité .... inférieure à la normale.
Coloration .... { primitive: grisâtre:
secondaire: verdâtre.
Aspect .... opalescent.
Transparence ..... incomplète.
Consistance .... filandreuse.
Odeur .... nulle.
Sapidité........... métallique.

Tournesol.

Neutre .... 1.
Alcalin .... 1.
Acide ....faiblement acide........ 1.
Amphotère .... 1.

Réactions chimiques.

CAzSH	rose clair	>	1.
AzH^3	chamois clair		1.
AzH^4Cl		<	1.
NaCl		>	1.
KCl			1.
$C^{12}H^{10}O^{10}$		=	1.
$C^6H^{12}O^6$			1.
HNa^2PO^4		>	1.
$Mg(AzH^4)PO^4$			1.

Cristallisation microchimique.

Hépatotoxines	
Sels acides	sulfocyanures.
Sels alcalins terreux	phosphate neutre de soude, NaCl — Carbonate d'ammoniaque.
Leucomaïnes	

Résumé Sialoscopique ....

Diathèse indiquée: uricémique (état virtuel).

Diagnostic: hépatique uricémique (état virtuel); dyspepsie; hyperchlorhydrie; précirrhose goutteuse; migraines.

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	1.
Coloration	grisâtre.
Aspect	boueux.
Transparence	opaque.
Consistance	glaireuse.
Odeur	variable.
Sapidité	métallique (?).

Tournesol.

Neutre		1.
Alcalin		1.
Acide	>	1.
Amphotère		1.

Réactions chimiques.

CAzSH	rose doré	>	1.
AzH^3	chamois clair précipité	>	1.
AzH^4Cl			1.
NaCl			1.
KCl			1.
$C^{12}H^{10}O^{10}$		0	1.
$C^6H^{12}O^6$			1.
H^2NaPO^4		>	1.
$Mg(AzH^4)PO^4$		0	1.

Cristallisation microchimique.

Hépatotoxines	urobiline, urate de soude, taurine, hippurate de chaux, créatine.
Sels acides	H^2NaPO^4.
Sels alcalins terreux	NaCl — carbonate de soude.
Leucomaïnes	

Résumé Sialoscopique ....

Diathèse indiquée: diathèse uricémique (état réel).

Diagnostic: maladies catarrhales (asthme..).

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	1.
Coloration	primitive: grisâtre; secondaire: verdâtre.
Aspect	opalescent.
Transparence	incomplète.
Consistance	filandreuse.
Odeur	nulle.
Sapidité	métallique.

Tournesol.

Neutre		1.
Alcalin		1.
Acide	>	1.
Amphotère	>	1.

Réactions chimiques.

CAzSH	rose doré		1.
AzH^3	chamois clair		1.
AzH^4Cl		<	1.
NaCl		>	1.
KCl			1.
$C^{12}H^{10}O^{10}$			1.
$C^6H^{12}O^6$			1.
H^2NaPO^4		>	1.
$Mg(AzH^4)PO^4$			1.

Cristallisation microchimique.

Hépatotoxines	urobiline, lactates de soude et de chaux.
Sels acides	
Sels alcalins terreux	
Leucomaïnes	

Résumé Sialoscopique ....

Diathèse indiquée: hépatisme uricémique (état virtuel).

Diagnostic: eczéma.

Quant au sarcome, que nous avons rattaché à la diathèse uricémique, nous croyons pouvoir lui donner la formule salivaire suivante:

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	normale.
Coloration	nulle.
Aspect	boueux.
Transparence	semi-lucide.
Consistance	liquide.
Odeur	nulle.
Sapidité	nulle.

Tournesol.

Neutre		1.
Alcalin		1.
Acide	faible	1.
Amphotère		1.

Réactions chimiques.

CAzSH	$<$	1.
AzH^3		1.
AzH^4Cl	$>$	1.
NaCl		1.
KCl		1.
$C^{12}H^{10}O^{10}$		1.
$C^6H^{12}O^6$		1.
HNa^2PO^4	$<$	1.
$(MgO)AzH^4OPhO^5$	$>$	1.

Cristallisation microchimique.

Hépatotoxines	indigo, créatine.
Sels acides	
Sels alcalins terreux	carbonate d'ammoniaque.
Leucomaïnes	$>$ 1.

Résumé Sialoscopique ....

Diathèse indiquée: diathèse uricémique.

Diagnostic: sarcome; diagnostic confirmée par l'analyse du sang.

TROUBLES NERVEUX ET ALTÉRATIONS DES TISSUS GENGIVAUX DENTAIRES DANS LA DIATHÈSE URICÉMIQUE VRAIE.

(1) *Névrose:* Thermoanesthésie; névralgie du maxillaire; odontalgie; névrospasmes.

(2) *Ligaments:* Arthrodinie temporo-maxillaire; périostite aigue; dégénérescence amyloide; pyorrhée alvéolo-dentaire; desmeedynie.

(3) *Gencives:* Turgescence marginale; tumescence régionale; ulcération phagédénique; ulorrhagie; epulis (sarcome fibrome); stomatites aphteuse, ulcéro-membraneuse.

(4) *Dents:* Ébranlement des dents; chevauchement; carie active; chute des dents.

(Voir le tableau, page 354.)

B—Ce TABLEAU (page 354) nous permet d'établir la carte suivante:

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	$<$1.
Coloration	variable.
Aspect	louche.
Transparence	incomplète.
Consistance	visqueux.
Odeur	fade (acetone).
Sapidité	sucrée ou amère.

Tournesol.

Neutre		1.
Alcalin		1.
Acide	$>$	1.
Amphotère		1.

Réactions chimiques.

CAzSH	$>$	1.
AzH^3	précipité $>$ ou régulière $<$	1.
AzH^4Cl	$<$	1.
NaCl	$>$	1.
KCl		1.
$C^{12}H^{10}O^{10}$	$=$	1.
$C^6H^{12}O^6$	$>$	1.
HNa^2PO^4	$>$	1.
$Mg(AzH^4)PO^4$	$>$	1.

Cristallisation microchimique.

Hépatotoxines	$>$
Sels acides	
Sels alcalins terreux	
Leucomaïnes	$>$

Résumé Sialoscopique ....

Diathèse indiquée: diathèse uricémique; glycosémie.

Diagnostic: diabète avec phosphaturie.

(C) *État des dents:* Pyorrhée alvéolo-dentaire; gingivite tumescente saignant: carie des dents active; rapide ébranlement des dents par dégénérescence scléreuse du périoste suivi de chûte-tartre dentaire.

(Voir le tableau, page 355.)

B—Ce TABLEAU (page 355) nous permet d'établir la carte suivante comme type de la salive des neuro-arthritiques rhumatisants:

SIALO-SÉMÉIOLOGIE ANALYTIQUE.

Caractères organoleptiques.

Quantité	normale.
Coloration	incolore.
Aspect	d'eau claire.
Transparence	complète.
Consistance	liquide.
Odeur	inodore.
Sapidité	variable.

Tournesol.

Neutre		1.
Alcalin		1.
Acide	$>$	1.
Amphotère		1.

Réactions chimiques.

CAzSH		1.
AzH^3	$>$	1.
AzH^4Cl		1.
NaCl	$=$	1.
KCl		1.
$C^{12}H^{10}O^{10}$		1.
$C^6H^{12}O^6$		1.
H^2NaPO^4		1.
$Mg(AzH^4)PO^4$	$>$	1.

Cristallisation microchimique.

Hépatotoxines	urobiline.
Sels acides	oxalates d'ammoniaque.
Sels alcalino terreux	
Leucomaïnes	variables.

Résumé Sialoscopique ....

Diathèse indiquée: diathèse oxalémique (Neuro-arthritiques).

Diagnostic: migraine, nevralgies, vertiges—Rhumatisme vrai—Neurasthénie.

De plus, nous noterons que la neurasthénie est particulièrement caractérisée par la présence des phosphates ammoniaco-magnésiens.

Enfin, nous avons rattaché à la diathèse oxalurique, le carcinome. En effet, chez les carcinomateux, les oxalates abondent dans le sang.

Il nous a semblé que, chez ces malades, tous les éléments chimiques de la salive sont en infériorité, si bien qu'on a:

$$\begin{array}{ll} CAzSH & <1 \\ AzH^3 & <1 \\ Cl & <1 \end{array}$$

Dans la dernière période de la maladie, toutes les réactions chimiques deviennent négatives ($CAzSH$, AzH^3, $NaCl$) et la salive devient alcaline.

Cette formule salivaire indique toujours un état extrêmement grave.

III. HÉPATIQUES MIXTES.

Bein entendu, tous les tableaux que nous venons de publier ne sont que des schémas. Dans la pratique on ne rencontre que très rarement un type salivaire absolument pur. La plupart du temps, dans une analyse de salive, on trouve des caractères appartenant aux différentes classes de la famille hépatique.

Cela n'étonnera du reste personne, si l'on veut bien réfléchir qu'en clinique, un malade ne réalise qu'exceptionnellement la description classique de sa maladie.

Il y a donc une foule de formules d'hépatismes mixtes et nous ne saurions avoir la prétention de les donner toutes ici.

Nous voudrions toutefois attirer l'attention sur l'existence d'un hépatisme mixte, caractéristique des névroses (hystérie, chorée, éclampsie, épilepsie).

Dans cet hépatisme cholémique uricémique mixte, les réactions peuvent affecter deux types bien distincts:

(1) *Réactions régulières mineures:* Quantité normale; coloration grisâtre; aspect boueux; transparence faible; consistance fluide; odeur bilieuse; sapidité amère. Au tournesol: salive neutre ou alcaline. Ammoniaque supérieure aux sulfocyanures.

(2) *Réactions irrégulières majeures:* Quantité variable; coloration grisâtre; aspect variable; consistance variable; transparence variable; odeur nulle ou vireuse; sapidité acide, sucrée. métallique. Au tournesol: salive acide ou amphotère. Ammoniaque supérieure aux sulfocyanures.

C'est pour cela que l'on trouve ces malades à la fois rangées dans la diathèse cholémique et dans la diathèse uricémique.

En réalité, elles forment un groupe de transition entre les deux diathèses.

RÉSUMÉ GÉNÉRAL.

Ainsi, l'analyse de la salive nous mène d'une façon simple au diagnostic des états dyscrasiques.

Nous croyons que toutes les notions que nous avons exposées peuvent se synthétiser dans les deux tableaux suivants:

I. Différenciation graphique des réactions chimiques des diasthèses hypoacide et hyperacide.

	Normale. (État de Santé.)	Diasthèse hyperacide. (Goutte.)	Diasthèse hypoacide. (Lymphatisme.)
CAzSH	$=1$	$=1$	<1
AzH^3	$=1$	>1	>1
AzH^4Cl	$=1$	<1	>1
NaCl	$=1$	>1	$=1$
KCl	$=1$	$=1$	$=1$
*$C^{12}H^{10}O^{10} + H^2O$	$=1$	>1	<1
$C^6H^{12}O^6$	$=1$	$=1$	$=1$
$(NaO)^2(HO)^2PhO^5$	$=1$	>1	$<1^2$
$(MgO)A^2H^4OPhO^5$	$=1$	$=1$	$=1$

II. Schéma graphique des dyscrasies. (Cholémique, uricémique, oxalurie, glycocémique.)

	Cholémie.	Goutte. (État réel.)	Oxalémie Rhumatisme Neurasthénie.	Glycosémie. Diabète.
CAzSH	<1	$=1$	>1	$=1$
AzH^3	$=1$	>1	$=1$	$=1$
AzH^4Cl	>1	>1	<1	>1
NaCl	$=1$	>1	$=1$	>1
KCl	$=1$	$=1$	$=1$	$=1$
$C^{12}H^{10}O^{10} + H^2O$	<1	$=1$	>1	$=1$
$C^6H^{12}O^6$	$=1$	$=1$	$=1$	>1
$(NaO)^2(HO)^2PhO^5$	>1	>1	$=1$	>1
$(MgO)A^2H^4OPhO^5$	>1	$=1$	>1	$=1$

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* Le glycogène $C^{12}H^{10}O^{10}+H^2O$ est variable et proportionel dans les diathèses—inférieure ou supérieure à la normale.

A paper by Dr. C. F. W. Bödecker, Berlin, Germany, entitled "Percussion in Dental Diagnosis," was read by Dr. E. C. Kirk, as follows:

Percussion in Dental Diagnosis.*

By Dr. C. F. W. BÖDECKER, Berlin, Ger.

The first mention of percussion as a means of physical diagnosis is found in the works of Hippocrates, though it was not until 1722 that Avenbrugger (*Inventum novum*), and later Corvisart, Piorry, and others published its scientific principles and its application. Since that time much has been written on this subject from a medical standpoint, while in dental literature it is mentioned mostly during the last two decades. Percussion in dentistry has been considered solely as a means of eliciting pain in cases of advanced pericementitis. In the following, however, I will attempt to explain that the percussion note of a tooth affected with degenerations of the pulp, incipient pulpitis or pericementitis is altered long before percussion itself is painful.

Degeneration of the pulp tissue, as well as incipient non-purulent pulpitis, are diseases which often produce reflex phenomena in other parts of the body, and their location sometimes gives us much trouble, especially when the disease occurs in apparently sound teeth. Every dental practitioner of experience has met with patients who for months have suffered from what was supposed to be neuralgia of some branch of the trigeminus, the facial, the vagus, or even the brachial plexus, which subsequently was found to be caused by an irritation in the pulp of some tooth. The teeth in these instances, mostly are sound and give neither pain nor discomfort upon pressure or mastication. It is in these cases that percussion will be found to be of the greatest service in making the proper diagnosis.

To differentiate the normal from the abnormal percussion note, as the sound given out by the body percussed is called, requires some practice and an understanding of the principles underlying the production of sound.†

Physics teaches us that sounds may be divided into musical and non-musical or mixed sounds. The former are of longer duration and are produced by periodical sound waves with regular intervals, so aptly likened by Helmholtz to the long and regular swells of the ocean. The non-musical or mixed sounds are brought about by irregular sound waves, and may be compared to water whose surface is broken by waves of different heights and strength. The percussion note, and for that matter all sounds that do not possess the character of true musical sounds, are included under this head. In order to detect and understand variations of the percussion note, a knowledge of the elements or acoustic properties of sound in general is necessary. In percussion the most important of the elements are intensity, pitch, quality, and duration.

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* [For the theoretical portion of this paper I am indebted to my son, Henry W. C. Bödecker, B.S., M.D., D.D.S.—C. F. W. B.]

† The following works contain literature on this subject:

"Encyclopedia Britannica." New York, 1883, vol. xv, p. 815, and vol. vii, p. 593.

H. von Helmholtz. "Die Lehre von den Tonempfindungen." Braunschweig, 1896.

J. Tyndall. "On Sound; a Course of Eight Lectures." London, 1893.

Carhart. "Mechanics, Sound and Light." Ann Arbor, 1899.

Adolf Weil. "Handbuch und Atlas der Topograpnischen Percussion." Leipzig, 1880.

A. L. Loomis, "Lessons in Physical Diagnosis." New York, 1896.

Bödecker, "The Anatomy and Pathology of the Teeth." Philadelphia, 1894, p. 283.

Intensity or strength of a sound depends on the amplitude (height) of the sound waves, and varies directly as the strength of the percussion blow.

Pitch is determined by the length and rapidity of the waves. The smaller and more rapid the vibrations, the higher will be the tone, while the longer and slower the vibrations, the lower the tone. In dental percussion pitch is changed by the relative position of the tongue, lips, and the lower jaw. The best position for these parts during percussion is the one they assume during the act of singing. If the mouth is wide open and the soft palate is raised the resonance of the teeth will be higher in pitch than when the mouth is nearly closed and the soft palate is relaxed. Even under these conditions the pitch of almost every tooth varies slightly from that of its neighbor, or from the corresponding tooth of the opposite side. It is therefore impossible to lay down a definite rule for the pitch of the dental percussion note. Stress has been laid on the relatively unimportant subject of pitch, that the practitioner may not confound it with the most important element of the dental percussion note, that of *quality*.

Quality of sound, determined by the form of its waves, is that peculiar characteristic by which we may identify it as proceeding from a particular source. It depends on the fact that many sounds that reach the ear are not simple but really compound systems, being composed of a predominant tone, called the fundamental, and one or more secondary tones, the overtones. Upon these overtones, associated with the fundamental, the differences of form of the compound sound waves depend. The number of the vibrations of the fundamental determines the pitch of the compound sound, while the quality is determined by the number, the order, the relative intensity, and the relative phase of the overtones.

Duration of a given sound varies with its pitch. The higher the pitch the shorter the duration, and *vice versa.*

Of the four elements of sound described, namely intensity, pitch, quality, and duration, the one that almost exclusively concerns us in dental percussion is *quality*. The variations in the quality of the percussion note of greatest value to us, are three in number, and are designated as the clear, the dull, and the flat percussion note. The clear or normal percussion note is the one elicited by tapping upon the crown of a healthy tooth in the direction of its root, whose pericementum and adjacent tissues also are healthy. The tone in this instance will be a comparatively ringing one. All the other healthy teeth in the same mouth will have this same quality of ring, though all may vary in pitch. As soon as the tooth or its surrounding is diseased, the note loses its clear ringing quality and becomes dull. In the earliest stages dulness is but faintly perceptible, but, as the pathological process becomes more aggravated the dulness of the percussion note increases until at last, when all the ringing quality of the note has disappeared, we obtain an absolutely flat percussion note.

Upon the ability to recognize the slightest dulness in the percussion note depends the practitioner's success in locating the seat of the disease in its earliest stages. This appreciation of dulness can only be acquired through training the ear by practicing percussion whenever opportunity affords.

The technique of percussion differs somewhat in medicine from that employed in dentistry. In medicine mediate percussion is resorted to,—that is, the blow is struck with fingers or hammer, not on the surface. but on some intervening substance applied to it, the pleximeter or the index finger of the left hand. In our specialty, however, we use the immediate method of percussion,—that is, we tap with the handle of an excavator or any such instrument directly upon the tooth. The method of tapping may be briefly described as follows: Grasp the handle of the reversed instrument as though holding a pen, and with a slight movement at the wrist tap with the end of the handle against the tooth. In medicine percussion as a means of physical diagnosis is employed for eliciting sounds which, differing in intensity, pitch, quality, and duration, serve to mark the anatomical position and the pathological changes of the underlying organs. The percussion note of any area largely depends upon the amount as well as the physical condition of the vibrating tissue. The denser and more elastic the tissue. the greater the vibrating area and the clearer and louder the percussion note; on the other hand, the softer and more unelastic or spongy the tissue, the smaller the vibrating area and the flatter and softer the percussion note. In dental percussion the vibratory waves pass along the tooth with great ease and rapidity; when they reach the pericementum, however, their strength and rate of progress is very much decreased. If the blow has been more than the merest tap the vibration waves pass through the pericementum into the bone. Here again, if this tissue is in a normal state, their strength and rate of progress is greater than in the pericementum, but not as great as it was in the tooth. This is explained by the relative density of the three structures. As mentioned before the denser the tissue the more easily it will vibrate during percussion; therefore, of the three structures in question the tooth vibrating the most will give the predominant or fundamental note to the percussion sound. As teeth are never exactly of the same shape and size, the tone emitted by them will be different in each instance, and as the fundamental determines the pitch of the compound sound it will be readily understood why the pitch of the dental percussion note varies in each case. The tones given out by the vibration of the pericementum and the bone being less intense and less clear. will determine the overtones of the percussion note. The pericementum. the softest of the three structures, inhibits the vibrations to the greatest extent. If there is an absence of pericementum, as in implanted teeth firmly attached to the bone, we obtain a clear, hard percussion note; if the pericementum be normal, then we elicit a softer sound, the normal percussion note. If, however. the pericementum has through any cause, as infiltration, hyperemia, inflammation, or degeneration, lost its normal density and elasticity, its vibratory power will be diminished in proportion to its changed physical condition and the percussion note emitted will be dull or even flat. The vibrations of the bone structure, giving a tone hard in character will in the percussion note somewhat neutralize the softness produced by the vibrations in the pericementum. If then, the pericementum completely obstructs vibration, the percussion note becomes absolutely flat, having lost the hard tone heretofore received from the bone. The sound given out by the bone also varies, depending on density, amount of blood, etc., and distance from the antrum.

To illustrate more clearly the theory of the dental percussion note, we may take the example of the sound emitted by a clock standing upon a wooden table. The ticking sets up vibrations in the clock, and these being communicated to the table, increase the loudness and change the character of the sound. If now, we successively place cloth of increasing thickness between the table and the clock, the sound with each additional layer becomes duller and duller. To return to the original proposition, the tooth being the clock, the table the bone, and the cloth the pericementum, we readily see how, with variations in thickness and elasticity of the last tissue, the percussion note will be changed in character. Up to this point the effect of the pulp on the vibrations of the tooth has not been discussed. This was done in order to more simply explain the relations of the tooth to its surrounding structures during percussion. The pulp contributing its share to the volume of the tooth, may by an alteration in its physical character change the quality of the sound emitted by the tooth upon percussion. Greater tension due to blood pressure, or degenerations, or the presence of gases in the pulp, all influence the vibratory power of the whole tooth. We all have noticed the difference in the clearness of the sound when we strike a glass of plain water and when we do the same with a glass filled with effervescent water. Although this example is exaggerated, as the relative volume of the tooth to pulp and glass to water are not the same, yet the physical facts are nevertheless the same in each case.

From what has been said before, I believe it hardly necessary to give a detailed discussion of the effects upon the percussion note of different strengths of blow. In short, the stronger the blow, the farther will the waves penetrate into the surrounding tissues, so that for deep percussion, a hard, while for examining the pulp and the pericementum but slight taps are employed.

What can interfere with deep and superficial percussion, and what may change the quality of the note, has already been explained. One point more I wish to explain, that is the direction of vibratory waves in percussion. It must never be forgotten that the waves travel in the direction of the percussion blow. The vibrations being greatest in the direction in which the waves are traveling, they produce the chief factor in the sound emitted. If then they encounter any obstruction, the effect on the sound will be more marked than if this obstruction had lain off in some lateral direction.

From what has been said in the foregoing, it becomes evident that in percussion for our specialty we have to deal with quite faint, non-musical sounds, and I am sorry to state that it is difficult, if not almost impossible, for anyone not possessing some musical talent or training to accurately discriminate between dull and clear sounds. The writer having for many years noticed the change in the quality of the sound of the teeth affected with degenerations of the pulp, incipient pulpitis or pericementitis, mentioned this fact at one of the meetings of the First District Dental Society of the State of New York, in 1888 and later, in his work. Upon discussing this subject in private with dental friends, the writer was surprised to hear that these gentlemen were unable to notice any difference between the quality of the percussion sound of teeth affected with slight pulpitis or pericementitis, and the sound given out by tapping upon a sound tooth of the same mouth.

Soon after this occurrence the writer was consulted by one of our great singers, who suffered from pain in the *lower* incisor teeth, which, upon careful examination by means of a fine exploring instrument, proved to be sound. Hot and cold water applied to the teeth of the affected side of the mouth increased the pain but gave negative results as to the true locality of the trouble. Upon percussion, the writer found that the *upper* left first molar emitted a slightly dull sound, but neither pain nor discomfort was produced by the tapping upon any of the teeth in the mouth. When the upper molar was opened, the pulp removed, and the canals filled, the pain in the lower incisors ceased at once and never returned. During percussion the patient was asked whether he noticed any difference in the quality of the sounds elicited by the teeth, when he replied in the affirmative, stating at the same time that, in his opinion only those possessing musical training or talent would be able to hear this difference. This then explained my friends' inability to discriminate between dull and clear sounds in dental percussion. Since this occurrence, the writer has made it a rule, whenever searching for teeth affected with incipient pulpitis or slight pericementitis, to ask the patients whether they notice any difference in the quality of the sound given out by the affected tooth upon percussion. The result of this inquiry has been that usually all patients with musical talent or training notice the difference in the quality of the tone of the affected tooth upon percussion, while the others notice but little or no difference.

In physical examination we also have to consider the general condition of all the teeth in the mouth. In some instances, as explained before, the teeth of patients upon percussion always give out a dull sound. These teeth usually have short roots and are somewhat loose in their sockets, although their pericementum appears normal. Such patients may be young or in the prime of their lives, whereas we meet with persons quite old whose teeth, when firm in their sockets, give out a clear sound upon percussion. As mentioned before we have to take into consideration also the length as well as the number of the roots which the tooth possesses. As a general rule, we find that a tooth with two roots gives out on percussion a sound a trifle higher than does a tooth of but one root, while the upper canines and first molars elicit the clearest sound of all. Therefore, in making by means of percussion, a diagnosis, especially in the beginning, it is advisable to compare the sound of a tooth with that of its neighbor as well as with its fellow on the opposite side of the mouth. Although, as has been demonstrated by Zuckerkandl and others, in many instances the size, shape, and location of the antra in the same cranium may vary considerably. If this is the case, there will be a marked difference in the percussion sound of the teeth situated below each antrum. The four incisor teeth of the upper jaw, if normal, yield on percussion, sounds nearly equal in clearness, while the upper canines having the longest roots, as mentioned before, elicit the clearest sound of all. In a series of percussions from the upper first bicuspid to the upper second molar we notice a gradual increase in the pitch of the sound, due to the existence of the antrum, which, being filled with air and communicating with the nasal cavities, cause a more or less tympanic resonance.

If the pulp of a tooth, the pericementum, or its surrounding bone tissue is inflamed, the vibrating area will be small, and the sound elicited is correspondingly dull. By the inflammatory reaction the physical condition of the tissues is altered; they more or less return to their embryonal state, thereby altering, as we have seen, the resonance of these tissues. Therefore, when the pulp of a tooth is affected with an irritation, pulpitis, or the pericementum becomes inflamed, we shall be able to notice upon *slight* percussion a sound somewhat duller than the normal; while, its neighbor or its fellow on the opposite side of the mouth, upon percussion usually produces a sound of normal quality. In comparing the resonance of a tooth with that of its neighbor or its mate on the opposite side care must be exercised to strike the teeth in the same direction.

In cases of slight circumscribed pericementitis we are often enabled to localize the inflamed portion in the pericementum, unless this be situated on the mesial or the distal surface of the root, and unless the crown of the tooth stands in close contact with those of its neighbors. Percussion upon the crown of a tooth in the direction of the inflamed spot will produce a somewhat dull sound. Therefore, if pericementitis be located in the lingual portion of the root of the tooth, slight percussion upon the labial surface of the crown, in the direction of the inflammation, will produce a duller sound than that evoked when with the same instrument the tooth is tapped on the lingual surface. If, on the contrary, pericementitis be located in the apex of the root, percussion in that direction upon the crown of the tooth will evoke the characteristic dull sound. In this manner we are often enabled to ascertain which of the roots of a molar or of a first bicuspid may be inflamed.

The degree of dulness of the sound, as explained above, will depend upon the degree of the inflammatory condition of the pulp, the pericementum, and its surrounding bone tissue. An analogy we have noticed in the illustration of the clock; there the sound emitted became the duller the thicker the amount of cloth was upon which the clock stood; so in this instance, the more diffused the inflammation around the root of the tooth, the duller will be the sound and the greater the sensitiveness on percussion. In more advanced stages of acute pulpitis, or pericementitis on percussion of the affected tooth, we notice, besides a distinct dulness in sound, sensitiveness or pain, increasing in severity with the advance of the inflammatory process of the pericementum.

The writer has made use of this method of diagnosis in his daily practice for many years and is happy to state that by it he has been able to locate the most perplexing cases; and he sincerely hopes that by practice the majority of our profession may derive the same benefit by its employment.

Discussion.

Zahnarzt HERRMANN RAUHE, Düsseldorf, Germany (translated by Dr. W. D. Miller). Although I recognize the importance of the sense of pain brought about by percussion which we use to diagnose whether a tooth is alive or dead, I do not think we are in a position to diagnose by percussion alone; but the sound produced may be a valuable means of determining the condition about the root, especially where there are large abscesses or cysts or where the root extends into a cavity. In this case the sound will be different from that of a healthy tooth and with experience a definite conclusion may be arrived at.

Dr. M. L. RHEIN, New York, N. Y. I believe percussion has its use in dental diagnosis, but I do not coincide with the writer that any such extended use of it as he advocates will ever be a possibility. Yet I do not contend that some one particular person may not have a special auditory sense so trained and delicate that it may be an invaluable aid in the diagnosis of pathological conditions to an extent that would be an impossibility in another person. We all know the ordinary uses of percussion, and this paper has been well written and is a clear development of the subject.

Dr. R. H. HOFHEINZ. No doubt all of us have relied upon percussion to diagnose certain cases; most of us, however, have only differentiated between a normal tooth and a transplanted or replanted tooth. The great difficulty in the use of this method as advocated by Dr. Bödecker will be to educate the ordinary ear to the sounds of a normal tooth. It is only when we have established a normal sound—as the sound of A, after which a violin is tuned—that it will be possible for most of us to diagnose patho logical sounds.

The sound is duller in pericementitis than in the normal tooth. The more sound has to travel through organic tissue the less clear it is. If there is a hyperemic condition there is less possibility for the clear sound to be transmitted. An additional factor as to the sound of the first molar may be that the mesial root often perforates into the antrum. That will give an additional clearness of sound.

In diagnosing pulp-stones percussion may become of great service. We must look for a medium sound between the normal and the replanted tooth. There is here additional calcareous deposit and therefore possibly an additional clearness of sound. Provided there is great inflammation owing to the nodules, we have a duller or a more normal sound because the dulness of the pathological condition of the pulp would counteract the clearness which might have been brought about by the calcium deposits themselves.

There is no doubt that the most distinctive difference is that between a normal tooth and one that has been replanted; where the pericemental membrane is destroyed or is only embryonic tissue, and is therefore not as firmly formed as normal membrane, thus forming less obstruction between the bony walls.

Whether it is possible to use this diagnosis in all cases is questionable, because very few have the musical ear to discriminate between the relative sounds, as was well accentuated by the author of the paper.

Dr. R. C. YOUNG, Anniston, Ala. I think this is a practical means of diagnosing a case where the patient cannot assist us and cannot locate the pain. The writer says he can diagnose pulpitis and pericementitis — two things absolutely different. My idea of the ringing sound given out by percussion is that the capillaries are filled with blood and may act as a cushion. But when there is a peridental irritation there is no difficulty in finding it. Why? Because the capillaries are dilated and the pressure is greater.

I take an old excavator and a little warm gutta-percha and find that this gives a response of pain. Now touch the same tooth with a particle of ice and the patient will feel relieved. Put ice on a normal tooth and it will respond by pain. I think we shall have to depend more upon response by pain than upon percussion.

Dr. HERRMANN RAUHE, Düsseldorf, Germany, then read his paper "Zur Ætiologie und Therapie der Kalksalzarmut," as follows:

Zur Aetiologie und Therapie der Kalksalzarmut.

Von Zahnarzt HERMANN RAUHE, Düsseldorf.

DIE Ursachen der weitverbreitesten Volkskrankheit, welche unter dem Namen Caries der Zähne bekannt ist, sind mannigfacher Art. Die wichtigste und therapeutisch wohl am wenigsten beachtete Ursache der grossen Verbreitung der Zahncaries liegt in der durch die heutige Kulturernährung bedingten mangelhaften Kalksalzzufuhr.

Wenn man auch nach Black bis heute noch keinen nennenswerten Unterschied im Kalkgehalt der sogenannten kräftigen (der caries widerstehenden) und den sogenannten schwachen (caries empfänglichen) Zähne nachgewiesen hat, so bildet doch ohne Frage die Lebensweise respective die Ernährung den Hauptfactor der grösseren oder geringeren Widerstandsfähigkeit der Zähne gegen Caries. Ich gehe noch weiter und stimme mit Kleinsorgen und Röse darin überein, dass die geringe Zufuhr an geeigneten Nährsalzen die Cardinalursache der grossen Verbreitung der Caries ist.

Gerade bei sonst scheinbar gleich gearteten und unter fast gleichen Verhältnissen aufgewachsenen Individuen findet die oft beobachtete Verschiedenheit hinsichtlich der Disposition zur Caries allein ihre Erklärung in der Verschiedenheit der von den einzelnen bevorzugten Nahrung. In ein und derselben Familie finden wir häufig schon starke Unterschiede in der Cariesfrequenz. Während die Eltern noch äusserst kräftige Zähne besitzen, sind diejenigen der Kinder zuweilen so schwach, dass wir uns von unseren Füllungen kaum dauernden Erfolg versprechen können.

Diese so oft von uns beobachtete starke Degeneration des menschlichen Gebisses dürfen wir also keinesfalls allein auf Conto der verfeinerten Lebensweise setzen, wenn ja auch zugegeben werden muss, dass die Hartgebilde der Zähne, welche sich genetisch der jeweiligen Nahrungsbeschaffenheit anpassen, bei mangelndem Gebrauch der Zähne wieder

schwächer werden und nach Generationen dauernder Aussergebrauchsetzung verkümmern resp. schliesslich ganz verschwinden müssen, so lässt sich die rapide Degeneration der Zähne nicht allein aus der rein äusserlich und lokal wirkenden Ursache der verfeinerten Zubereitung der Speisen und dem dadurch verringerten Gebrauch der Zähne erklären. Die Hauptursache liegt in den inneren Stoffwechselverhältnissen, und ist darin zu suchen, dass die Nahrung der heutigen Culturmenschen zu wenig Kalksalze enthält, und weiterhin darin, dass die wenigen Kalksalze, welche die Hauptnahrungsmittel hier und da noch besitzen, durch den Zubereitungsprozess unwirksam gemacht oder gar entfernt werden.

In jüngster Zeit hat Kleinsorgen darauf hingewiesen, dass es sicherlich kein Zufall sei, wenn in den Ländern des grössten Fleischconsums, in Amerika und England, die ungünstigsten Verhältnisse in Bezug auf die Ausbildung und Ernährung der Zähne zu finden sind. Fleischspeisen, die Hauptnahrung der wohlhaben, den Klassen, enthalten überhaupt keine nennenswerten Kalksalze, und die Hauptnahrungsmittel der ärmeren Bevölkerungsschichten, Kartoffel—und Mehlspeisen sind gleichfalls als direkt kalkarm zu bezeichnen. Infolgedessen finden wir die Zahncaries in gleicher Weise sowohl bei der ärmeren Bevölkerung, als auch in wohlhabenderen Kreisen stark verbreitet. Dazu kommt noch, dass dem Getreide, welches in der heutigen Volksernährung einen breiten Raum einnimmt, durch einen umständlichen Schäl—und Mahlprozess, die wenigen Kalksalze, welche es enthält, genommen werden.

Nicht allein die chemische Analyse hat den mangelnden Kalkgehalt der von dem heutigen Kulturmenschen bevorzugten Nahrung nachgewiesen, sondern auch der praktische Versuch bei Tieren lehrt uns, dass bei ausschliesslicher Fütterung mit Fleisch oder mit anderen von uns bevorzugten kalksalzarmen Nahrungsmitteln Knochenerweichungen auftraten.

Es erübrigt sich wohl, noch besonders darauf hinzuweisen, dass zwischen den Hartgebilden des organischen Lebens ein enger Zusammenhang besteht, ich verweise hier nur auf die enge Verbindung mangelhafter Zahnbildung und Rhachitis. Da aber die Knochengebilde eine unweit grössere Vitalität haben, wie die harten Zahnsubstanzen, so lässt sich eine mangelhafte Kalksalzernährung unter sonst gleichguten hygienischen Verhältnissen an den Knochen schneller nachweisen, als an den Zähnen, umsomehr, als unsere heutigen Hilfsmittel nicht ausreichen, um den Ernährungs—und Wechselprozess der Gewebe des Zahnbeins und erst recht nicht derjenigen des Zahnschmelzes nachzuweisen. Dass aber beide bestehen, dürfte wohl kaum ein Physiologe bestreiten, umsoweniger, als ein Teil der höher entwickelten Säugetiere ein leicht zu beobachtendes Wachsen und Neubilden der Zahnsubstanzen heute noch besitzt. Ich denke hierbei an die Klasse der Nager. Aehnliches beobachten wir bei den Stosszähnen der Elefanten, welche auch eine starke Vitalität besitzen und auch nach Tomes und Miller bei Verletzungen entsprechende Heilung zeigen. Aber auch bei Menschen selbst haben wir genugsam Gelegenheit, die Neubildung von Zahnsubstanzen zu beobachten. Sei es, dass die Pulpa infolge Abnutzung des Zahnes Ersatzdentin oder bei irgendwelchen Reizwirkungen Dentikel bildet, oder sei es, dass bei Frakturen durch Callus und nachfolgende Dentinbildung oft Heilungen herbeigeführt werden.

Um auf die Tierversuche zurückzukommen, so wissen Sie alle, dass bei Schweinen, welche ausschliesslich mit der sehr kalksalzarmen Kartoffel gefüttert werden, die gleichen rhachitischen Erscheinungen auftreten können, wie wir sie beim Menschen beobachten. Versuche, welche dergestalt mit Geflügel angestellt wurden, dass man nur gereinigtes Getreide zur Fütterung verwandte, zeitigten bald Knochenerweichung, welche bei Zufuhr von Kalksalzen wieder schwand.

Speciell in Ihrem Lande hat man mit der Maisfütterung bei Schweinen schlechte Erfahrungen gemacht, es zeigten sich auch hier des öfteren Knochenerweichungen. Bei Fütterung von Hochwild in Gehegen mit Futterkalk beobachtete man regelmässig eine auffallend stärkere Geweihbildung. Ferner ist aus der Tierheilkunde bekannt, dass Kühe nach häufiger überstandener Tragzeit sehr leicht an Knochenschwäche erkranken, wobei sie fortwährend liegen und schwer zum Aufstehen zu bewegen sind, hier verschreibt der praktische Tierarzt stets mit gutem Erfolg Futterkalk.

Bei Tieren (Pflanzenfressern), welchen ausschliesslich Fleischnahrung gereicht wurde, sah man ähnliche Erscheinungen und wenn wir im allgemeinen bei den Fleischfressern keine entsprechende Schädigung sehen, so liegt dies daran, dass die fleischfressenden Tiere auch die Hartgebilde des erbeuteten Tieres zernagen und aufnehmen.

Leider bieten nun auch diejenigen pflanzlichen Nahrungsstoffe, welche normaler Weise ein grösseres Quantum von Kalksalzen enthalten sollten, häufig nicht genügend Kalksalze, da die Aussaugung des Bodens auf alten Kulturböden in der Nachbarschaft der grossen Städte bei den Pflanzen selbst wiederum einen Kalksalzmangel herbeiführt. Röse will allerdings durch seine Untersuchungen den Nachweis geführt haben, dass die pflanzlichen Gebilde auch auf kalkarmen Boden stets ein gewisses physiologisch notwendiges Quantum an Kalksalzen aufnehmen. Dies erscheint umso unwahrscheinlicher, wenn man berücksichtigt, dass rein pflanzenfressende Tiere, wie zum Beispiel Rinder, unter ungünstigen Verhältnissen infolge Kalksalzmangel an Knochenbrüchigkeit erkranken können. Diese Erkrankung tritt besonders nach langer Dürre ein, wenn der Boden nicht genügend Feuchtigkeit zur Lösung und Zuführung der Kalksalze zu den Gräsern empfangen hat. Charakteristisch ist es, dass in solchen Fällen zunächst immer das Milchvieh erkrankt, welches eben einen grossen Teil von Kalksalzen mit der Milch abgeben muss.

Wenn wir nun gesehen haben, dass die Hartgebilde des menschlichen Körpers unter der verfeinerten Lebensweise und der mangelhaften Kalkzufuhr leiden, so ist der Schaden besonders bei den Zähnen ein doppelter, weil auch noch durch die geringe mechanische Inanspruchnahme des menschlichen Gebisses bei der Zerkleinerung der verfeinerten Nahrung, die Vitalität kaum angeregt wird, und weil diese an sich schon geringe Vitalitätsanregung nun auch noch nicht einmal genügend Kalksalze vorfindet, um eine Erneuerung und Vermehrung der Zellen der Hartgebilde zu ermöglichen. Aus diesem Grunde sehen wir bei Frauen während der Schwangerschaft eine ungewöhnlich schnell erscheinende starke Cariesdisposition. Die Kalksalze, welche der Organismus bisher zur notdürftigen Erhaltung und Ernährung der Zahngewebe hergeben konnte, werden zum Aufbau der Hartgebilde der Frucht verbraucht.

Der Mangel unserer Nahrungsmittel an Knochensalzen zeitigt nun noch weitere Erkrankungen und Schäden, für welche man bisher andere Ursachen verantwortlich machen zu müssen glaubte.

Der unter dem Namen Alveolar pyorrhoe bekannte Zerfall der Alveolarränder dürfte auch zum grössten Teil seine Ursache in der mangelhaften Knochenzufuhr durch ungeeignete Nahrung haben. Jedenfalls leidet der äusserst dünne Alveolarrand bei mangelhafter Ernährung am ersten. Einmal ist die Ernährung desselben infolge der anatomischen Verhältnisse äusserst schwierig und anderenteils befördern die hier häufig vorkommenden mechanischen Reise und der leichte Zugang für pathogene bacterien den durch langsamen Stoffwechsel herbeigeführten Zerfall. Für diese Theorie spricht die Tatsache, dass wir der Alveolarpyorrhoe am häufigsten bei solchen Patienten begegnen, welche gut leben, das heisst solchen, welche der kalksalzarmen Nahrung den Vorzug geben, und welche ausserdem überhaupt wenig Bewegung und wenig Stoffwechselanregung haben.

Des weiteren hat Kleinsorgen kürzlich eine Erklärung für den von uns Zahnärzten so oft beobachteten Zusammenhang zwischen Chlorose und Cariesdisposition gegeben. Er weist darauf hin, dass bei der grossen physiologischen Rolle, welche der Knochen—und speciell das Knochenmark bei der Bereitung der roten Blutkörperchen spielen, bei mangelhafter Knochenbildung und Ernährung eine mangelhafte Blutbildung die direkte Folge sein muss, und sind auch hier der Therapie, welche bisher die Chlorose durch Eisenpräparate behandelte neue Wege eröffnet, und auch bei der Chlorose sehen wir bei geeigneter Knochensalzzufuhr gute Erfolge.

Für den Zusammenhang zwischen Blutarmut und Zahnweichheit spricht noch der Grund, dass wir bei chlorotischen Patienten einen ausgesprochenen Kalk—und Kreidehunger beobachten. Ein solch inniger Zusammenhang von Kalk—und Blutarmut entspricht auch dem häufigen Vorkommen beider Erkrankungen. Kleinsorgen hat dann noch den Nachweis geführt, dass die Gefahr an Eisenmangel zu leiden bei unserer heutigen Diät ganz gering ist, während die Gefahr des Kalksalzmangels bei unseren Hauptnahrungsmitteln besonders in Erscheinung tritt. Schliesslich sei noch als nicht zu unterschätzender Beweis der von demselben Autor nachgewiesene therapeutische Erfolg der Knochensalzzufuhr bei Blutarmut und verwandten Schwächezuständen angeführt.

Angesichts dieses tatsächlichen Mangels an Kalksalzen in unserer heutigen Ernährung entsteht nun die Frage, woher sollen wir unseren Bedarf an Zahn—und Knochen bildenden Substanzen nehmen unter der Garantie, dass wir dem Organismus in genügender hinreichender Menge die notwendigen Kalksalze zuführen.

Wie schon längst dem abgemagerten, muskelgeschwächten Körper mit bestem Erfolge concentrierte Eiweiss—präparate zugeführt werden und wie schon lange bei Blutarmut mit gutem Erfolge Blutpräparate gegeben werden, so liegt nichts näher, als diesen Weg der Organotherapie weiter zu verfolgen und den kalksalzarmen Menschen ein Knochenpräparat zu geben, dass die für Zahn und Knochenbau erforderlichen Salze in einer Form enthält, die eine möglicht ausgiebige physiologische Ausnutzung in Körper gewährleistet.

In jüngster Zeit hat nun die Nahrungsmittelchemie unter der Bezeichnung Ostasalze ein organisches Präparat gezeitigt, welches aus Knochen hergestellt wird, und welches daher alle die für den Zahn—und Knochenbau notwendigen Bestandteile in unveränderter vitaler Zusammensetzung enthält. Zunächst hat man diese Ostasalze mit Zwieback verbunden und ist die Analyse wie folgt:

	Per Cent.
Kohlenhydrate	68.20
Eiweisssubstanzen	12.89
Fett	7.41
Holzfaser	0,44
Wasser	4.80
Mineralbestandteile	6.94

Die Mineralbestandteile enthalten:

Phosphorsauren Kalk	86.4
Phosphorsaure Magnesia	5.4
Kohlensauren Kalk	1.2

ferner: Schwefelsauren Kalk. Chloride, Kali- und Natronverbindungen u. s. w.

Wir haben zahlreiche Ernährungsversuche mit Osta-Salzen gemacht und bin ich in der Lage, Ihnen an 2 Abbildungen zu zeigen, welchen günstigen Einfluss die Osta-Ernährung auf das Kind eines Kollegen ausübte; es wurde hier auch die Mutter während der Gravidität mit Osta-Biskuits ernährt.

Da nun Biskuits und Chocoladen durch den Zusatz von Osta nicht an Wohlgeschmack einbüssen und sehr gut vertragen werden, so dürfte der zahnärztliche Arzneischatz um ein allen Ansprüchen genügendes, vollwertiges Nährmittel bereichert sein.

In wenigen Monaten hoffe ich die genaue Ergebnisse weiterer Versuche veröffentlichen zu können, und sollte es mich freuen, wenn ich dann auch von Ihrer Seite Versuche gegeben sehen könnte mit den Ercichnungen mittelst der organischen Kalksalze.

Dr. W. D. Miller, Berlin, read a summary in English of Dr. Rauhe's paper, as follows:

Deficiency of Calcium Salts.

The chief cause of caries is deficiency of calcium salts. Caries is not brought on so much by change of habits as by the fact that the lime salts of our foods are made useless by the way in which they are prepared. The wealthier class of Americans live on meat, which contains little lime salts, while the poorer classes live chiefly on starchy substances which likewise contain very little. The result is that both classes suffer much from caries. These salts are taken out of our food by our cooking methods, which deposit them on the sides of the cooking utensils. Experiments with animals show that lack of calcium softens their bones. Deficiency of these salts shows itself more readily in the bones than in the teeth. Hogs fed on potatoes have soft bones, while game fed on large quantities of lime salts develop stronger horns and bones than where the amount is less abundant. As to the effect of the amount of lime in the soil on vegetables, Röse concludes that whether the soil be rich or poor in salts, their quantity in plants grown on these soils will be subject to but slight variations. The essayist does not agree with Röse and cites the fact that after a long drought, when there is not enough moisture to dissolve the lime salts in the earth, the plants do not take up enough to nourish the animals feeding upon them, and weakness of their bones is the result. Women suffer from caries especially when the strain of forming the bones of a fetus is put upon them. Pyorrhea alveolaris may be accounted for by the lack of lime in the

food. He also thinks there is a connection between chlorosis and anemia and such deficiency, as good results have been obtained in these cases by the administration of calcium salts.

Discussion.

Dr. W. D. Miller, Berlin, Ger. The question of the pathology of calcium-salts-deficiency has been much discussed in Germany, especially by Röse, who thinks that the susceptibility to caries noted in different districts could be accounted for in this way. Recently, however, he has modified his views, and in his last lecture on this subject he said that it did not make much difference where a plant was cultivated, its calcium constituents would be about the same. We also know that a hard and a soft tooth contain about the same amount of lime salts. Röse has been indefatigable in his investigations upon this subject. In some districts both the soil and the water contain large quantities of calcium salts and yet the people have bad teeth. He says that in this case, however, the people do not drink the ordinary water but preserve the rain water and drink that.

Again, he says even in districts containing much calcium in the earth and water people may suffer from caries because it is precipitated in the boiling process to which we subject our foods. You see there are many factors to be considered before a conclusion can be arrived at. Röse is of the opinion that undoubtedly where there is a large percentage of lime salts in the water, which remain in solution in it after it is boiled, those who use such water will have well-developed teeth and will suffer little from caries. Whether he still maintains that idea to its full extent I do not know. A few weeks ago he expressed the opinion that the relative immunity to caries was due to the strong alkaline reaction of the saliva.

Herr Rauhe has carried the question farther on, to the connection between calcium-deficiency and other diseases. I have no doubt that there is something in this. Many foods contain less lime salts than are necessary. A child brought up on buckwheat cakes and tapioca puddings and the like will receive less of the salts than are necessary to build up his growing skeleton. But we who live on a normal diet obtain all the salts we need.

Herr Rauhe has told us that the bone is first affected by the deficiency. I took four pups from the same litter and fed two normally, and the other two with artificial milk and other foods containing little or no lime salts. I found the latter two grew more slowly and that their bones were so soft that knots could have been tied in them. Their teeth, however, were perfectly normal and just as well developed as those of the dogs fed on normal food.

The conclusion is that the bones are affected much sooner than the teeth. In people who live in regions defective in lime salts we should accordingly expect to find bone diseases more frequently than is the case. I am not aware that bone diseases are especially frequent where caries is frequent. This is an objection that I have made to Dr. Röse and he has not yet given me an answer with which I was perfectly satisfied.

Dr. G. W. Cook, Chicago, Ill. I think this subject has been discussed for many years. The old theory was that calcium salts were necessary to plant life. Later physiological studies have shown, as has been stated, that it does not matter whether the plant food is rich in it or not, that the plant reaps the necessary quantity of calcium.

There seems here to be a condition of nutrition, and I believe there is some physical law that enters into this that we are not familiar with. The salts do not exist in the circulation as salts; they are in a dissociated condition, and when they are formed in a bone or tooth-structure they are formed there under a physical law. The crystals that form the enamel of the tooth-structure are living under a certain physiological pressure, so that the formation of the crystals is looser in some and more compact in others. All the quantitative proportions are present, but not in proper combination to make a strong tooth.

In the physio-chemical laws involved in the building up of organic substances we have as much energy stored up in it as was required to build it up. Now if the kinetic energy be not great enough we have not sufficient resistance to keep down the action of these enzymes or acids.

This subject requires the most careful thought and discussion. Some teach that there is no difference between a hard and a soft tooth—that all are the same in their physical characteristics—and yet one cuts easier than the other. We are ready—practically ready—to say that there is a difference in the structure of that tooth. Then what is the difference? It must be in the combination rather than in the quantity of calcium salts.

From my polariscopic observations extending over the last year to determine the crystallization of these organic salts the results promised are interesting, and I feel that we are not getting at the root of the difference of tooth-structure, as we call it at the present time. I believe that if we study the crystallization of the inorganic salts and how their combinations come together it will be of great value.

Dr. J. A. Fischer, St. Louis, Mo. I wish to make a remark as to the nourishment of teeth. In the case of crumbling teeth we are advised to give calcium phosphate. I think no matter how much of the salts we give internally, if they do not enter the animal organism, and are merely eliminated as they are given, they are useless even though we give them by the pound. In order to get results we may take ground bone. I used the shells of eggs ground into a powder and administered for a long time. In the offspring of the persons so treated the teeth have been found to be very strong in structure. If animals do not get the proper food they will suffer from rickets and have cleft palate, as was shown in the "Zoo" in London, where a lioness who was fed on food deficient in these substances had a cub that showed the deficiency, and afterward when her food was changed she had another cub which was perfectly sound.

Dr. M. L. Rhein, New York, N. Y. I have for many years been impressed with the fact that there is a form of caries of the teeth in which this question of the amount of calcium salts taken into the system has a strong bearing. This is a particular kind of caries, I believe. I think it is different from the average form of caries. To make that clear I will call attention to a certain class of immigrants who come to this country, especially from the north of Ireland, where they have been brought up on a diet strong in calcium salts and phosphates. They use oatmeal in a rough state which requires good use of the teeth in mastication, and there is good assimilation of the food products. My experience is that these Irish immigrant girls come here with beautiful strong teeth, but that the teeth soon deteriorate and that rapid caries plays an important part in this. I believe that the change of food they get in this country accounts for this loss of their former immunity to caries. This point is also illustrated in the case of pregnant women, where decay of the teeth occurs in the same way.

What this relationship is scientifically we have not yet demonstrated, but it is easy for us to assert that there is no degeneration of the interior of a tooth—that is, to oppose the views advanced by Dr. E. S. Talbot of Chicago, on this subject; but the falsity of his views has never been demonstrated. His explanation is that the tissues are deprived of their calcium salts and phosphates. We have no right to decry the proposition unless we can prove its falsity. To me its bearing upon the question seems logical, although I admit that no proof of its accuracy has been given. In a pregnant woman who lacks calcium salts and phosphates, the result is seen in a rhachitic child. But it is a most interesting study to see how these deficiencies in enamel formation on deciduous teeth and on the first permanent molars ceases from the moment that the child is subsistent upon its own nutrition. It is to me a most demonstrable fact that the mother lacks the nutrition to form this enamel surface in the child *in utero*.

I want to state a little point in corroboration of Dr. Talbot's theory that there is a possibility that the teeth of the mother not only are starving for want of these salts, but that they are robbed of their own calcium salts and phosphates to supply this deficiency. This corroboration is found in the clinical observation of the teeth in infantile scorbutus, a condition not often observed. In scorbutus the rapid destruction of the deciduous teeth, their complete annihilation, occurs in a way that can never be accounted for by the condition of the oral fluids or external influences.

These cases are so rare that it is good fortune to be able to observe one. But after having seen a tooth almost disappear in such a case it is impossible to form a rational conclusion upon the process except upon the supposition that there is a retrograde metamorphosis of the inorganic constituents. I know this is contrary to our accepted doctrine, but I can see no other explanation except that nature simply grasps this inorganic material to supply the crying need for it in the bones of the body.

Scientifically I have nothing to offer in corroboration of Dr. Talbot's views on the degeneration of the teeth themselves, but clinical observation seems to me to indorse strongly that theory.

Dr. G. W. COOK, Chicago, Ill. Dr. Rhein said that the deficiency was in the inorganic substances. My opinion is that it is due rather to a deficiency in the activity of the organic substances. It is simply a piece of laboratory work, the building up a tooth-structure.

Dr. RHEIN. I want to ask if you have ever seen a case of infantile scorbutus.

Dr. COOK. Plenty of them.

Dr. RHEIN. They are not very common.

Dr. COOK. No, I know they are not. For fifteen years my brother has been at the head of a children's sanitarium where we see from twenty-five to fifty children a week in all stages of development and disease. Being a dentist and also interested in the bacteriological work carried on in the institution, I made clinical and bacteriological studies of the mouths of these children. We tried some experiments of increasing the quantity of calcium salts fed to the children. There were public formulas of diets for certain children. But now they begin to study the individual child's diet and foodstuff instead of the diet of all children irrespective of their condition.

Dr. Jonathan Taft read a paper before a Michigan society in which he brought up this question. We had the opportunity of feeding a number of these children, and I asked permission to make a formula in which we increased all the inorganic salts to see what effect it had on the bone and teeth-structures. After four years of observation, one child that seemed to have the best nutrition of any of them, so far as organic substances were concerned, had the poorest teeth and after a little time developed rickets and is now unable to get around; it is lodged in bed and kept so that its legs and arms may not become distorted. I am fully convinced from a clinical and scientific standpoint that the power behind it all is of an *organic* nature, and that the teeth will take up only a certain amount of calcium salts, and that the condition is due to the physical arrangement of the inorganic compounds—not so much the quantity as the arrangement of the crystallization.

Dr. RHEIN. Then you make the point that the basic organic substance is lost in these cases, leaving the inorganic substance unprotected?

Dr. COOK. No, it is a question of deposition. We may stimulate the pneumogastric nerve and produce an effect on digestion. Then, owing to the lack of proper digestion and assimilation the inorganic salts are not carried up to the tooth so as to be deposited there. When a disturbance such as pregnancy occurs it possibly changes the organic structure. The basic matrix of the tooth is organic. Now the disturbance does not cause the disintegration, but it changes the molecular arrangement of that salt so that it is more easily broken down. The energy has been changed from a potential to a kinetic energy, operating to destruction rather than to stability.

Dr. RHEIN. You admit that there are conditions due to absolute lack of phosphatic and calcium nutrition?

Dr. COOK. I do not believe I would admit that, because we fed these children a superabundance of that food. Some time I may have to take back what I have said. But in certain acute infectious diseases, such as diphtheria and scarlet fever, we observed a lack in the formation of enamel; when the child has the disease before the eruption or during formation of the teeth, ridges and grooves will be seen. Whether the teeth contain the proper quantity of inorganic salts or not I am unable to say.

Dr. RHEIN. I differentiate very decidedly between the markings formed in life and those formed *in utero*. One shows the evidence of some nervous effect on food assimilation. But I do not grant the same for the enamel defects on the deciduous teeth and those found on the enamel of the first permanent molars.

Dr. COOK. The investigations have not been carried on sufficiently to determine whether we have a lack in quantity of calcium salts in different teeth. Dr. Hinkins and myself tried to determine the difference in the quantity of calcium salts in teeth weighing the same, but we got so deep in the subject that we did not carry it to any extensive conclusion. It was Dr. Black's investigations that led us to take this question up.

Dr. RHEIN. Dr. Miller substantiated your view yesterday, I think.

Dr. COOK. Yes, I think it is in the arrangement of the inorganic constituents rather than in their quantity.

Dr. HERRMANN RAUHE—translated by Dr. Fischer (closing the discussion). I do not agree with Dr. Black. It is not the relative question of the deposition of calcium salts upon which caries depends, but with the relative nutrition in general. Naturally that organ which is the least nourished will be the least important for that particular organism. Therefore, animals not sufficiently supplied with these salts show the lack first in the bones. It is different with the human being. Man excels principally because his bony structure is of the highest development, and his intelligence depends largely upon the complete structure of the bones. Therefore in Dr. Miller's experiment the bones were affected before the teeth. In a human being the teeth will suffer first.

The CHAIRMAN. We wish to thank Dr. Rauhe for his excellent paper. I am grieved that the paper was not presented before. I think, however, the discussion which it has elicited has been of the best in this section.

The paper by Dr. JUAN FALERO, City of Mexico, Mex., "Civilization as a Factor in the Atrophy and Disappearance of the Third Molar," was read by title. It here follows:

Civilization as a Factor in the Atrophy and Disappearance of the Third Molar.

By Dr. JUAN FALERO,

PROFESSOR OF OPERATIVE DENTISTRY, MEXICAN DENTAL COLLEGE, CITY OF MEXICO.

IF any change whatever in the functions of an organ be sufficient to excite the attention of thinking men and induce them to undertake investigations as to the causes of that change, with much greater reason should they study the disappearance of an organ, however insignificant it may appear.

I am alluding to the disappearance of the third molar or "wisdom tooth," the presence of which has up to the present been considered permanent in spite of the fact that our daily observation proves the contrary.

As a matter of fact, this molar was never wanting in the primitive races; at least it is so asserted by all authors who have studied the matter, and the skulls of the ancient Egyptians as well as those that are preserved in the different museums of Europe prove the existence of this organ in all adults who had passed the age of twenty-five years.

We who live in Mexico find ourselves in a specially favorable condition to observe a change that is taking place in our organism, and to which I desire to call the attention of this learned gathering. I say that we are in specially favorable surroundings, because here we have before our eyes an Indian race in all its purity, whose magnificent teeth we can admire and compare with those of their descendants of mixed race and with those of the natives of Europe who reside among us.

In the magnificent collection of ancient skulls that is to be found in our National Museum we have seen this molar in all developed jaws, and in more than 2000 mouths of Indians whom we have examined in the states of Yucatan, Campeche, Tabasco, Chiapas, Vera Cruz, Oaxaca, and Puebla we found only one in which this tooth was not fully developed. With the single exception noted, I found the third molar in good condition, and neither badly formed nor out of place, as frequently happens among ourselves.

Among the Europeans or their descendants whom we daily attend in the work of our offices hardly seventy-five per cent. possess these molars, and it is noted that when they have these teeth they are seldom in good condition. They rarely have the four—the natural number—while many have only two, generally the lower ones.

In view of this deficiency or omission it occurs to us to ask whether it is not to be attributed to our way of living and to the slight use we make of our teeth.

It is well known that the Indian seldom makes use of condiments to flavor his food, that this food is always the same—being very simple, rather cold than hot—and that he uses no further appliances than his own teeth and jaws. In fact, his teeth are for him real knives, with which he cuts meat, peels sugar-cane, cuts string, or picks bones; of his molars we can say that they are true mills which pulverize everything that comes within their reach. In addition to this function the Indian makes use of his jaws as if they were a third hand: he employs them to hold the reins of his horse, to support his clothing and arms while fording rivers, to graduate the weight of a load by lifting it first with his teeth, and so throughout the whole round of occupations. We can easily understand that such exercise is conducive to great development of his jaws, in which the teeth are well rooted and have sufficient space for their full and free development.

If we accept as a scientific truth that the functions fulfilled by any organs—that is to say their exercise—develop and strengthen them, while the want of exercise debilitates and atrophies them, we find an eloquent argument for this theory in the teeth.

It is a fact that our teeth are far from executing the work for which nature has designed them. Our food is brought to the table in a state of soft preparation, due to the cooking to which it is previously subjected and to the division we make of it with a knife; the teeth therefore really fulfill a secondary office. This want of exercise appears to me to be the determining cause of the atrophy of our molars and jaws, and, consequently, of the lack of space to allow the development of the third molar.

If to this we add that the Indian is naturally sober, is beyond the great emotions connected with civilized life, leads a tranquil life, retires early, does not smoke, is exempt from syphilis, we may consider all these circumstances favorable to the prevention of that debilitation of the organism so often found in civilized races. These factors constitute proof, further, that customs and habits exercise great influence in the development and preservation of the teeth.

During the existence of slavery in Cuba the African negroes employed on the plantations were exceedingly muscular, and although treated like animals were otherwise obliged to lead a quiet and methodical life, and consequently never suffered from caries; now, however, while they lead a civilized life, and especially so in the cities, they have lost their vigor, and most of them are victims of syphilis; and their teeth, which formerly could be taken as models of texture and beauty, now suffer from caries just as much as those of civilized persons.

I therefore come to the following conclusions:

(1) The third molar is always found in the Indian at the age of twenty years in as well developed a condition as any of the other teeth, and it makes its appearance as an entirely physiological act without any difficulty whatever.

(2) The third molar is also invariably found in the halfbreeds, but it does not appear as early as in the Indian, often not before the age of twenty-five years. Moreover, its eruption does not take place in a normal manner as in the Indian, since it is frequently accompanied by more or less intense inflammation due to the effort made by the tooth to occupy its proper place in the jaw.

(3) The third molar is an organ that is not invariably found in Europeans or their descendants, as it is possessed by only seventy-five per cent. of them, and then in a defective form and more or less out of place, while its duration is shorter than in the races above mentioned. As in the Indian and halfbreed, this tooth commences to erupt at the age of eighteen, but with Europeans and their descendants it does not complete its development before the age of thirty. In the latter case the eruption is often accompanied by facial neuralgia, inflammation, abscess, and fever, all which disorders are caused by want of space in the jaw and pressure of the organ on the tissues in its endeavor to occupy its proper place. This want of space is at times so evident that the extraction of the previous molar becomes necessary, and cases have been known in which the third molar has remained buried within the jaw on account of the entire want of space within which it could appear.

The truth is that we have never seen in an Indian a case of trismus, or any other complication whatever that could be attributed to any difficulty in the eruption of the third molar, while in Europeans disorders accompanying its eruption are frequent, and sometimes assume a serious character.

If, therefore, the same case assumes such distinct characteristics according to the origin of the person, to what must we attribute this difference?

In the Indian the eruption of the third molar is an entirely normal and physiological evolution without any pathological consequences of any kind, while in the European it is the frequent cause of more or less serious disorders.

The CHAIRMAN. I think we have every reason to congratulate ourselves upon the work of this section. We have had two essays which have received the highest honors—that of Prof. W. D. Miller and that of Dr. Eugene S. Talbot.

There being no further business before the section, Section II is now adjourned *sine die*.

END OF THE FIRST VOLUME.

FAUCHARD
HAYDEN
CARABELLI
HARRIS
LINDERER
TOMES
SAUER
TURNER
DUBOIS